Electronic Supplementary Material (ESI) for Chemical Communications

Palladium-catalyzed insertion of *α*, *β*-unsaturated *N*-tosylhydrazones and trapping with carbon nucleophiles

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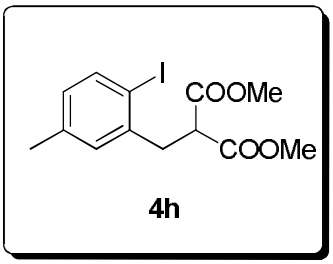
1. General Remarks

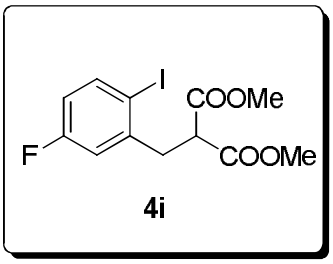
Column chromatography was carried out on silica gel. ^{1}H NMR spectra were recorded on 400 MHz in $CDCl_3$ and ^{13}C NMR spectra were recorded on 100 MHz in $CDCl_3$. All products were further characterized by HRMS (high resolution mass spectra). Copies of their ^{1}H NMR and ^{13}C NMR spectra were provided. THF, and toluene, 1,4-dioxane were dried over Na with benzophenone-ketyl intermediate as indicator. MeCN was distilled over P_2O_5. Commercially available reagents and solvents were used without further purification. Compounds **1**[1], *α*, *β*-unsaturated *N*-tosylhydrazones **2**[2] and **4a**[3] were synthesized according to the literature procedure.

2. Characterization Data of 4h and 4i



4h

dimethyl 2-(2-iodo-4-methylbenzyl)malonate 4h: white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.67 (d, J = 8.0 Hz, 1H), 7.04 (d, J = 2.0 Hz, 1H), 6.74 (dd, J = 2.0 Hz, J = 8.4 Hz, 1H), 3.86-3.82 (m, 1H), 3.70 (s, 6H), 3.29 (d, J = 8.0 Hz, 2H), 2.25 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 168.9, 139.8, 139.4, 138.3, 131.3, 129.7, 96.2, 39.2, 20.8.



4i

dimethyl 2-(4-fluoro-2-iodobenzyl)malonate 4i: white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.76 (dd, J = 5.6 Hz, J = 8.8 Hz, 1H), 6.99 (dd, J = 2.8 Hz, J = 9.6 Hz, 1H), 6.73-6.68 (m, 1H), 3.84-3.81 (m, 1H), 3.73 (s, 6H), 3.31 (d, J = 8.0 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 116.6, 164.1, 161.6, 142.4, 142.3, 140.8, 140.7, 117.8, 117.6, 116.3, 116.1, 93.1, 93.0, 52.7, 51.3, 39.3.

3. General procedure for the preparation of 3, 5 and 6

1) General procedure for the preparation of 3

Under a nitrogen atmosphere, to an oven-dried Schlenk tube were added dimethyl 2-(2-iodophenyl)malonate **1a** (0.30 mmol, 1.0 eq), *N*-tosylhydrazones **2** (0.675 mmol, 2.25 eq), $Pd_2(dba)_3{\cdot}CHCl_3$ (2.5 mol%), L_2 (15 mol%), K_2CO_3 (1.575

mmol, 5.25 eq) and THF (4 mL). The mixture was stirred at room temperature for 15 minutes and then stirred at 60°C for 8h. The resulting mixture was cooled to room temperature and filtered through celite with EtOAc as eluents. The solvents were evaporated under reduced pressure and the residue was purified by flash chromatography on silica gel to afford pure **3**.

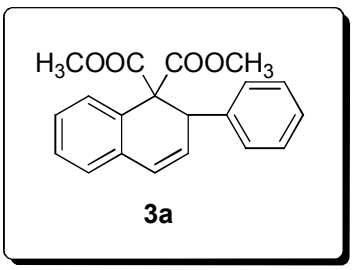
2) General procedure for the preparation of 5

Under a nitrogen atmosphere, to an oven-dried Schlenk tube were added **4** (0.30 mmol, 1.0 eq), *N*-tosylhydrazones **2** (0.675 mmol, 2.25 eq), $Pd_2(dba)_3{\cdot}CHCl_3$ (5 mol%), PPh_3 (30 mol%), K_2CO_3 (1.575 mmol, 5.25 eq) and THF (4 mL). The mixture was stirred at room temperature for 15 minutes and then stirred at 60°C for 5h. The resulting mixture was cooled to room temperature and filtered through celite with EtOAc as eluents. The solvents were evaporated under reduced pressure and the residue was purified by flash chromatography on silica gel to afford pure **5**.

3) General procedure for the preparation of 6

Under a nitrogen atmosphere, to an oven-dried Schlenk tube were added substituted iodobenzene (0.30 mmol, 1.0 eq), *N*-tosylhydrazones **2** (0.675 mmol, 2.25 eq), BTAC (0.6 mmol, 2.0 eq), $Pd_2(dba)_3{\cdot}CHCl_3$ (2.5 mol%), L_3 (20 mol%), K_2CO_3 (0.9 mmol, 3.0 eq), THF (1 mL). The mixture was stirred at room temperature for 15 minutes. Meanwhile, a solution of dimethyl malonate (1.818 mmol, 6.06 eq) in THF (1 mL) was slowly added to a suspension of NaH (1.8 mmol, 6.0 eq) in THF (3 mL) at 0 °C. The remaining solution was washed with 0.5 ml of THF. The mixture was stirred at room temperature for 5 min and set aside for use in the following step. Finally, the sodium malonate solution was added to Schlenk tube via syringe and was washed with 0.5 ml of THF. Then, the reaction mixture was heated at reflux for 8h. The resulting mixture was cooled to room temperature and filtered through celite with EtOAc as eluents. The solvents were evaporated under reduced pressure and the residue was purified by flash chromatography on silica gel to afford pure **6**.

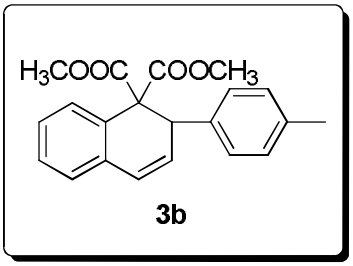
4. Characterization Data of 3a-3k



3a

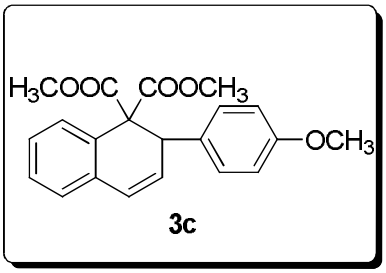
dimethyl 2-phenylnaphthalene-1,1(2H)-dicarboxylate 3a: oil. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.56-7.54 (m, 1H), 7.30-7.22 (m, 2H), 7.19-7.09 (m, 4H), 7.07-7.04 (m, 2H), 6.51 (d, J = 9.6 Hz, 1H), 6.12 (dd, J = 6.0 Hz, J = 10.0. Hz, 1H), 4.51 (d, J = 6.0 Hz, 1H), 3.63 (s, 3H), 3.42 (s, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 170.1, 169.3, 137.4, 133.0, 131.7, 129.8, 128.9, 128.9, 128.4, 128.4, 128.3, 128.2, 127.7, 126.5,

125.4, 63.0, 53.0, 52.1, 46.8. HRMS (ESI) Calcd for $C_{20}H_{18}O_4$: M+H = 323.1278. Found: 323.1284.



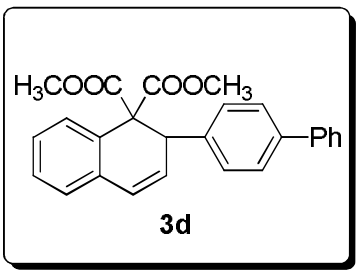
3b

dimethyl 2-(p-tolyl)naphthalene-1,1(2H)-dicarboxylate 3b: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.55 (d, *J* = 7.6 Hz, 1H), 7.29-7.21(m, 2H), 7.10 (d, *J* =6.8 Hz, 1H), 6.96-6.92 (m, 4H), 6.49 (d, *J* = 10.0 Hz, 1H), 6.20 (dd, *J* = 5.6 Hz, *J* = 9.6 Hz, 1H), 4.48 (d, *J* = 5.6 Hz, 1H), 3.62 (s, 3H), 3.45 (s, 3H), 2.22 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 170.1, 169.2, 137.3, 134.2, 133.1, 131.6, 130.0, 129.0, 128.9, 128.7, 128.4, 128.3, 128.3, 127.7, 126.4, 125.2, 62.9, 53.0, 52.0, 46.4, 21.0. HRMS (ESI) Calcd for $C_{21}H_{20}O_4$: M+H = 337.1434. Found: 337.1349.



3c

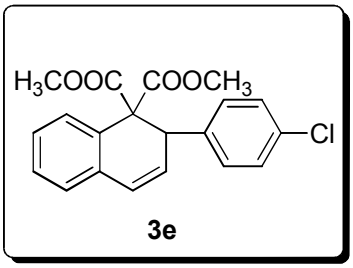
dimethyl 2-(4-methoxyphenyl)naphthalene-1,1(2H)-dicarboxylate 3c: white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.55 (d, *J* = 7.6 Hz, 1H), 7.30-7.21 (m, 2H), 7.12-7.09 (m, 1H), 6.97 (d, *J* = 8.4 Hz, 2H), 6.68 (d, *J* = 8.8 Hz, 2H), 6.48 (d, *J* = 9.6 Hz, 1H), 6.10 (dd, *J* = 6.0 Hz, *J* = 9.6 Hz, 1H), 4.47 (d, *J* = 5.6 Hz, 1H), 3.69 (s, 3H), 3.63 (s, 3H), 3.47 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 170.1, 169.3, 159.1, 133.1, 131.7, 130.2, 129.9, 129.3, 128.4, 128.4, 127.7, 126.5, 125.1, 113.6, 63.0, 55.0, 53.0, 52.1, 46.0. HRMS (ESI) Calcd for $C_{21}H_{20}O_5$: M+H = 353.1384. Found: 353.1390.



3d

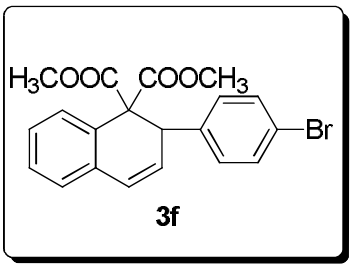
dimethyl 2-([1,1'-biphenyl]-4-yl)naphthalene-1,1(2H)-dicarboxylate 3d: white solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.58 (d, *J* =7.2 Hz, 1H), 7.51-7.49 (m, 2H), 7.40-7.35 (m, 4H), 7.30-7.22 (m, 3H), 7.15-7.12 (m, 3H), 6.53 (d, *J* = 9.6 Hz, 1H), 6.14 (dd, *J* = 5.6 Hz, *J* = 9.6 Hz, 1H), 4.57 (d, *J* = 6.0 Hz, 1H), 3.65 (s, 3H), 3.46 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 170.0, 169.3, 140.5, 140.4, 136.5, 133.1, 131.6, 129.9, 129.8, 129.8, 129.3, 129.0 128.9, 128.6, 128.5, 128.4, 127.8, 127.6,

127.2, 127.0, 126.9, 126.9, 126.6, 125.6, 63.0, 53.1, 52.1, 46.5. HRMS (ESI) Calcd for $C_{26}H_{22}O_4$: M+Na = 421.1410. Found: 421.1417,



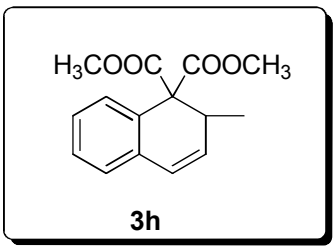
3e

dimethyl 2-(4-chlorophenyl)naphthalene-1,1(2H)-dicarboxylate 3e: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.54 (d, *J* = 7.6 Hz, 1H), 7.32-7.24 (m, 2H), 7.13-7.11(m, 3H), 6.98(d, *J* = 8.4 Hz, 2H), 6.51 (d, *J* = 8.4 Hz, 1H), 6.08 (dd, *J* = 6.0 Hz, *J* = 9.6 Hz, 1H), 4.49 (d, *J* = 6.0 Hz, 1H), 3.64 (s, 3H), 3.47(s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 169.9, 169.2, 136.1, 133.6, 132.8, 131.6, 130.2, 129.6, 129.4, 129.4, 128.9, 128.6, 128.4, 128.2, 127.9, 126.6, 125.8, 62.9, 53.1, 52.2, 46.0. $C_{20}H_{17}ClO_4$: M+Na = 379.0708. Found: 379.0715.



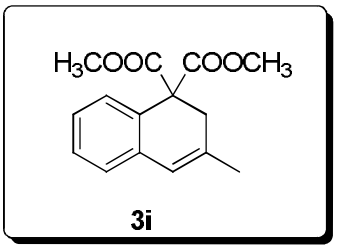
3f

dimethyl 2-(4-bromophenyl)naphthalene-1,1(2H)-dicarboxylate 3f: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.54-7.52 (m, 1H), 7.31-7.23 (m, 4H), 7.13-7.11(m, 1H), 6.92 (d, *J* = 8.4 Hz, 2H), 6.51 (d, *J* = 9.6 Hz, 1H), 6.07 (dd, *J* = 6.0 Hz, *J* = 9.6 Hz, 1H), 4.48 (d, *J* = 5.6 Hz, 1H), 3.64 (s, 3H), 3.47 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 169.8, 169.1, 136.6, 132.8, 132.3, 131.6, 131.4, 130.6, 129.9, 129.8, 129.7, 129.3, 129.0, 128.6, 128.2, 127.9, 126.6, 125.8, 121.8, 62.8, 53.1, 52.2, 46.1.



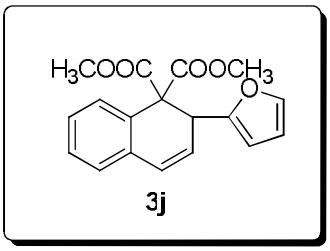
3h

dimethyl 2-methylnaphthalene-1,1(2H)-dicarboxylate 3h: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.43-7.40 (m, 1H), 7.25-7.22 (m, 2H), 7.05-7.03 (m, 1H), 6.34 (d, *J* =9.2 Hz, 1H), 5.99 (dd, *J* = 5.2 Hz, *J* = 9.6 Hz, 1H), 3.75 (s, 3H), 3.68 (s, 3H), 3.35-3.28 (m, 1H), 1.08 (d, *J* =7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 170.7, 169.9, 143.2, 132.8, 132.6, 130.4, 130.0, 129.8, 128.9, 128.3, 128.2, 127.3, 126.3, 125.3, 62.8, 52.8, 52.4, 35.1, 15.5. HRMS (ESI) Calcd for $C_{15}H_{16}O_4$: M+H =261.1121. Found: 261.1132.



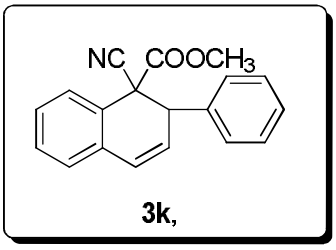
3i

dimethyl 3-methylnaphthalene-1,1(2H)-dicarboxylate 3i: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δppm 7.26-7.22 (m, 1H), 7.19-7.12(m, 2H), 7.02 (d, J = 7.6 Hz, 1H), 6.21(s, 1H), 3.75 (s, 6H), 2.93 (s, 2H), 1.93 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 171.6, 135.5, 134.1, 130.0, 128.4, 128.3, 127.4, 126.5, 125.7, 122.4, 59.8, 53.0, 36.0, 23.0. HRMS (ESI) Calcd for $C_{15}H_{16}O_4$: M+H = 261.1121. Found: 261.1133.



3j

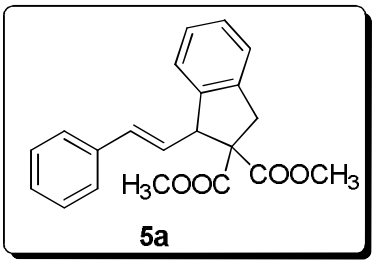
dimethyl 2-(furan-2-yl)naphthalene-1,1(2H)-dicarboxylate 3j: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.42 (m, J = 7.6 Hz, 1H), 7.29-7.21 (m, 3H), 7.10 (dd, J = 1.2 Hz, J = 7.2 Hz, 1H), 6.53 (d, J =9.6 Hz, 1H), 6.21-6.20 (m, 1H), 6.10-6.04 (m, 2H), 4.72 (d, J = 5.6 Hz, 1H), 3.68 (s, 3H), 3.64 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δppm 169.8, 169.4, 151.0, 142.2, 132.5, 130.5, 129.2, 128.4, 127.7, 127.1, 126.6, 126.3, 110.4, 108.5, 62.5, 53.1, 52.6, 40.3. HRMS (ESI) Calcd for $C_{18}H_{16}O_5$: M+H = 313.1071. Found: 313.1076.



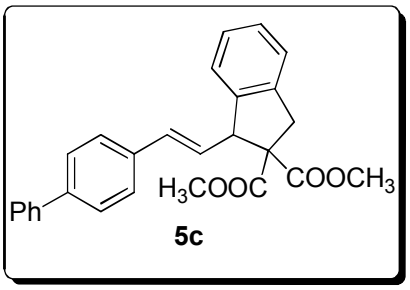
3k,

methyl 1-cyano-2-phenyl-1,2-dihydronaphthalene-1-carboxylate 3k: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.38-7.36 (m, 1H), 7.31-7.26 (m, 7H), 7.23 (d, J =8.0 Hz, 1H), 6.72 (dd, J = 2.0 Hz, J = 9.6 Hz, 1H), 6.11 (dd, J = 4.4 Hz, J = 10.4 Hz, 1H), 4.47 (dd, J = 2.0 Hz, J = 4.0 Hz, 1H), 3.78 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 168.2, 136.3, 136.2, 129.8, 129.1, 128.8, 128.7, 128.6, 128.6, 128.5, 128.0, 127.6, 127.4, 127.2, 116.8, 53.3, 53.9, 47.3. HRMS (ESI) Calcd for $C_{19}H_{15}NO_2$: M+H = 290.1176. Found: 290.1181.

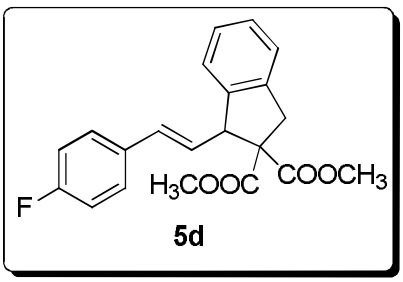
5. Characterization Data of 5a-5j



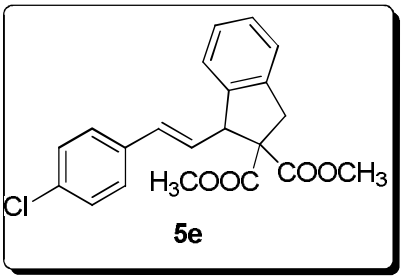
(E)-dimethyl 1-styryl-1H-indene-2,2(3H)-dicarboxylate 5a: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.31 (d, J = 7.2 Hz, 2H), 7.28-7.24 (m, 2H), 7.22-7.17 (m, 5H), 6.59 (d, J = 15.6 Hz, 1H), 6.08 (dd, J = 4.2 Hz, J = 10.6 Hz, 1H), 4.78 (d, J = 9.2 Hz, 1H), 3.92 (d, J = 16.8 Hz, 1H), 3.73 (s, 3H), 3.62 (s, 3H), 3.39 (d, J = 16.8 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 171.7, 170.0, 142.5, 139.3, 136.8, 132.7, 128.5, 127.5, 127.2, 126.4, 124.8, 124.3, 65.4, 54.5, 52.9, 52.5, 39.2. HRMS (ESI) Calcd for $C_{21}H_{20}O_4$: M+H = 337.1434. Found: 337.1449.



(E)-dimethyl 1-(2-([1,1'-biphenyl]-4-yl)vinyl)-1H-indene-2,2(3H)-dicarboxylate 5c: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.58-7.50 (m, 4H), 7.43-7.38 (m, 4H), 7.33-7.30 (m, 1H), 7.24-7.18 (m, 4H), 6.63 (d, J = 15.6 Hz, 1H). 6.13 (dd, J = 9.6 Hz, J = 15.6 Hz, 1H), 4.81 (d, J = 9.2 Hz, 1H). 3.94 (d, J =16.8 Hz, 1H), 3.74 (s, 3H), 3.64 (s, 3H), 3.41 (d, J = 16.8 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 171.8, 170.1, 142.5, 140.6, 140.3, 139.3, 135.9, 132.3, 128.7, 127.6, 127.3, 127.3, 127.2, 127.2, 127.0, 126.9, 126.8, 124.9, 124.3, 65.5, 54.6, 52.9, 52.6, 39.3.

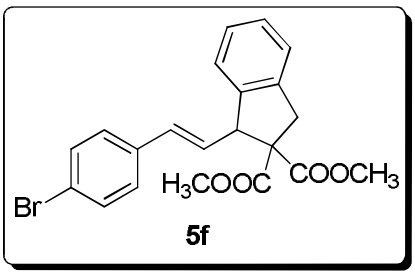


(E)-dimethyl 1-(4-fluorostyryl)-1H-indene-2,2(3H)-dicarboxylate 5d: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.29-7.26 (m, 2H). 7.24-7.16 (m, 4H), 6.98-6.93 (m, 2H), 6.55 (d, J =15.6 Hz, 1H), 6.00 (dd , J = 9.2 Hz, J =15.6 Hz, 1H), 4.77 (d, J = 9.6 Hz, 1H), 3.91 (d, J = 16.4 Hz, 1H), 3.74 (s, 3H), 3.62 (s, 3H), 3.39(d, J =16.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 171.7, 170.0, 142.4, 139.3, 131.5, 127.9, 127.8, 127.6, 127.2, 127.0, 127.0, 124.8, 124.3, 115.5, 115.3, 65.4, 54.4, 52.9, 52.5, 39.2. HRMS (ESI) Calcd for $C_{21}H_{19}FO_4$: M+H = 355.1340. Found: 355.1357.



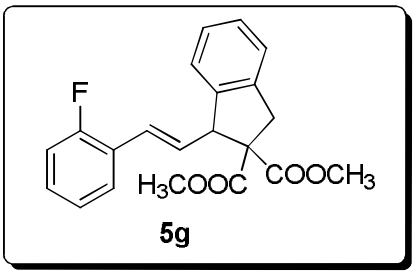
5e

(E)-dimethyl 1-(4-chlorostyryl)-1H-indene-2,2(3H)-dicarboxylate 5e: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7,23-7.16 (m, 8H), 6.54 (d, J = 16.0 Hz, 1H), 6.07 (dd, J = 9.2 Hz, J = 15.6 Hz, 1H), 4.77 (d, J = 9.6 Hz, 1H), 3.91 (d, J = 16.4 Hz, 1H), 3.74 (s, 3H), 3.61 (s, 3H), 3.39 (d, J = 16.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 171.6, 170.0, 142.2, 139.3, 135.3, 133.2, 131.5, 128.6, 128.0, 127.6, 127.5, 127.2, 124.8, 124.3, 65.4, 54.4, 52.9, 52.5, 39.2. HRMS (ESI) Calcd for $C_{21}H_{19}ClO_4$: M+Na = 393.0867. Found: 393.0875.



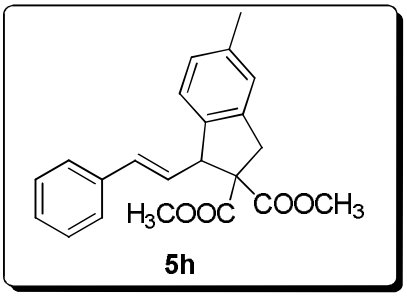
5f

(E)-dimethyl 1-(4-bromostyryl)-1H-indene-2,2(3H)-dicarboxylate 5f: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.39 (d, J = 8.4 Hz, 2H), 7.22-7.17 (m, 6H), 6.52 (d, J = 15.6 Hz, 1H), 6.08 (dd, J = 9.6 Hz, J = 13.2 Hz, 1H), 4.77 (d, J = 9.2 Hz, 1H), 3.91 (d, J =16.8 Hz, 1H), 3.74 (s, 3H), 3.62 (s, 3H), 3.39 (d, J =16.8 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δppm 171.6, 170.0, 142.2, 139.3, 135.7, 131.6, 131.5, 128.1, 127.6, 127.2, 124.8, 124.4, 121.3, 65.4, 54.4, 52.9, 52.5, 39.2. HRMS (ESI) Calcd for $C_{21}H_{19}BrO_4$: M+Na = 437.0359. Found: 437.0362.



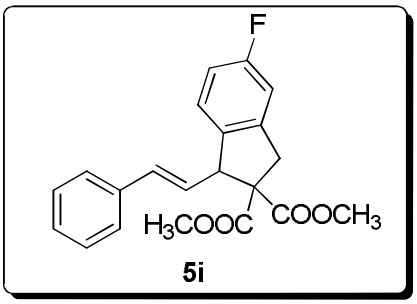
5g

(E)-dimethyl 1-(2-fluorostyryl)-1H-indene-2,2(3H)-dicarboxylate 5g: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.37 -7.33 (m, 1H), 7.24-7.14 (m, 5H), 7.05-6.97 (m, 2H), 6.75 (d, J = 15.6 Hz, 1H), 6.15 (dd, J = 9.6 Hz, J = 16.0 Hz, 1H), 4.80 (d, J = 9.6 Hz, 1H), 3.92 (d, J = 16.4 Hz, 1H), 3.74 (s, 3H), 3.65 (s, 3H), 3.40 (d, J = 16.4 Hz, 1H). ^{13}C NMR (400 MHz, $CDCl_3$) 171.7, 170.0, 142.3, 139.3, 130.0, 129.9, 128.8, 128.8, 127.6, 127.5, 127.5, 127.2, 125.3, 125.2, 124.8, 124.7, 124.6, 124.3, 124.0, 124.0, 115.7, 115.5, 65.5, 54.9, 52.9, 52.5, 39.2. HRMS (ESI) Calcd for $C_{21}H_{19}FO_4$: M+H = 355.1340. Found: 355.1342.



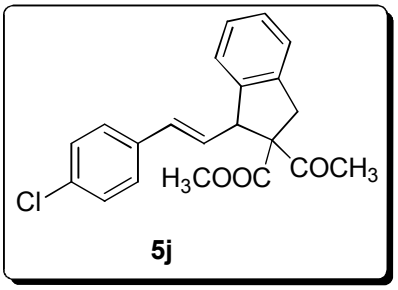
5h

(E)-dimethyl 5-methyl-1-styryl-1H-indene-2,2(3H)-dicarboxylate 5h: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.32-7.30 (m, 2H), 7.27-7.22 (m, 2H), 7.21-7.16 (m, 1H), 7.07-7.04 (m, 2H), 6.99 (d, J = 7.6 Hz, 1H), 6.57 (d, J = 15.6 Hz, 1H), 6.07 (dd, J = 9.2 Hz, J = 15.6 Hz, 1H), 3.88 (d, J = 16.4 Hz, 1H), 3.73 (s, 3H), 3.61 (s, 3H), 3.35 (d, J = 16.8 Hz, 1H), 2.31 (s, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 171.7, 170.1, 139.5, 139.4, 137.2, 136.9, 132.5, 128.4, 128.3, 128.0, 127.4, 126.3, 124.9, 124.5, 65.6, 54.1, 52.8, 52.4, 39.1, 22.6, 21.2. HRMS (ESI) Calcd for $C_{22}H_{22}O_4$: M+H = 351. 1591. Found: 351.1607.



5i

(E)-dimethyl 5-fluoro-1-styryl-1H-indene-2,2(3H)-dicarboxylate 5i: light yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) 7.32-7.25 (m, 4H), 7.24-7.18 (m, 1H), 7.12-7.09 (m, 1H), 6.92-6.85 (m, 2H), 6.57 (d, J = 15.6 Hz, 1H), 6.06 (dd, J = 9.2 Hz, J = 15.6 Hz, 1H), 4.73 (d, J = 9.2 Hz, 1H), 3.89 (d, J = 16.8 Hz, 1H), 3.74 (s, 3H), 3.62 (s, 3H), 3.36 (d, J = 17.2 Hz, 1H). ^{13}C NMR (400 MHz, $CDCl_3$) 171.5, 169.8, 141.5, 141.4, 138.0, 138.0, 136.7, 132.9, 128.5, 127.6, 126.9, 126.3, 126.0, 125.9, 115.5, 114.3, 114.1, 111.5, 111.3, 65.8, 53.7, 52.9, 52.5, 39.1. HRMS (ESI) Calcd for $C_{21}H_{19}FO_4$: M+H = 355.1340. Found: 355.1357.

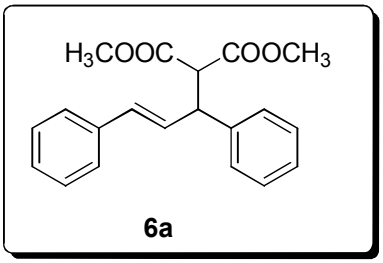


5j

(E)-methyl 2-acetyl-1-(4-chlorostyryl)-2,3-dihydro-1H-indene-2-carboxylate 5j: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.26-7.19 (m, 8H), [6.65 (d), 6.54 (d), J = 15.6 Hz, 1H)], [6.10 (dd), 5.98(dd), J = 9.6 Hz, J = 16.0 Hz, 1H)], 4.83-4.78 (m, 1H), 3.93 (d, J = 16.8 Hz, 1H), [3.78 (s), 3.65 (s), 3H], 3.33-3.25 (m, 1H), [2.27 (s),

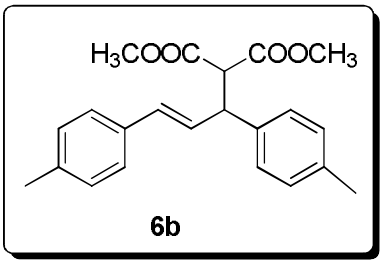
2.15 (s), 3H]. ^{13}C NMR (400 MHz, $CDCl_3$) 201.8, 172.7, 170.8, 142.5, 142.1, 139.4, 138.7, 135.3, 135.0, 133.3, 133.1, 131.4, 128.6, 128.4, 127.7, 127.6, 127.6, 127.5, 127.3, 127.2, 124.8, 124.7, 124.5, 124.4, 71.7, 71.5, 54.2, 52.9, 52.7, 52.4, 38.1, 37.5, 28.1, 26.6. HRMS (ESI) Calcd for $C_{21}H_{19}ClO_3$: M+Na = 377.0915. Found: 377.0922.

6. Characterization Data of 6a-6j

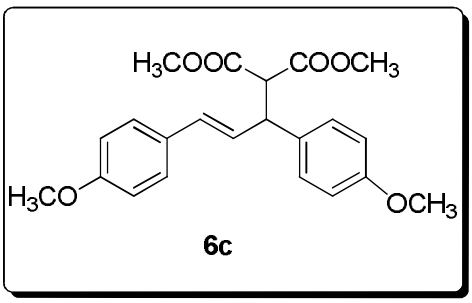


(E)-dimethyl 2-(1,3-diphenylallyl)malonate 6a: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.32-7.16 (m, 10H), 6.48 (d, J = 15.6 Hz, 1H), 6.33 (dd, J = 8.4 Hz, J = 15.6 Hz, 1H), 4.27 (dd, J = 8.8 Hz, J = 10.8 Hz, 1H), 3.96 (d, J = 10.8 Hz, 1H), 3.69 (s, 3H), 3.50 (s, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.1, 167.7, 140.1, 136.7, 131.8, 129.1, 128.6, 128.4, 127.8, 127.5, 127.1, 126.3, 57.6, 52.5, 52.4, 49.1. HRMS (ESI) Calcd for $C_{20}H_{20}O_4$: M+H = 325.1434. Found: 325.1250

The date match with the previous report.[4]

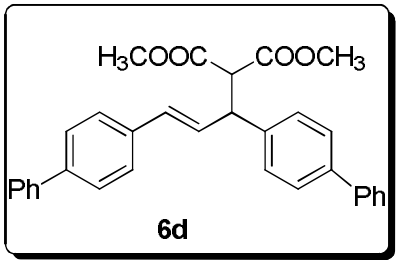


(E)-dimethyl 2-(1,3-di-p-tolylallyl)malonate 6b: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.20-7.16 (m, 4H), 7.10 (d, J = 8.0 Hz, 2H), 7.06 (d, J = 8.0 Hz, 2H), 6.43 (d, J = 16.0 Hz, 1H), 6.26 (dd, J = 8.4 Hz, J = 15.6 Hz, 1H), 4.24-4.19 (m, 1H), 3.93 (d, J = 10.8 Hz, 1H), 3.67 (s, 3H), 3.51 (s, 3H), 2.29 (s, 6H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.2, 167.8, 137.2, 136.6, 134.0, 131.4, 129.3, 129.0, 128.2, 127.6, 126.2, 57.7, 52.4, 52.3, 48.8, 21.0, 20.9. HRMS (ESI) Calcd for $C_{22}H_{24}O_4$: M+Na = 375.1567. Found: 375.1571.



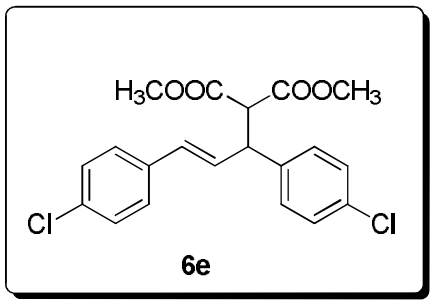
(E)-dimethyl 2-(1,3-bis(4-methoxyphenyl)allyl)malonate 6c: light yellow oil. ^{1}H

NMR (400 MHz, $CDCl_3$) 7.24-7.19 (m, 4H), 6.85-6.78 (m, 4H), 6.39 (d, *J* = 15.6 Hz, 1H), 6.18 (dd, *J* = 8.8 Hz, *J* = 16.0 Hz, 1H), 4.22-4.18 (m, 1H), 3.90 (d, *J* = 10.8 Hz, 1H), 3.75 (s, 6H), 3.68 (s, 3H), 3.51 (s, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.1, 167.8, 159.0, 158.4, 132.3, 130.8, 129.5, 128.7, 127.4, 127.1, 113.9, 113.7, 57.8, 55.1, 55.0, 52.4, 52.2, 48.3. HRMS (ESI) Calcd for $C_{22}H_{24}O_6$: M+Na = 407. 1465. Found: 407.1462.



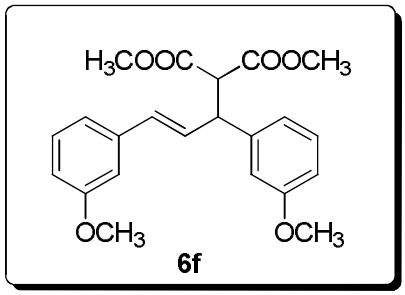
6d

(E)-dimethyl 2-(1,3-di([1,1'-biphenyl]-4-yl)allyl)malonate 6d: light yellow oil. ^1H NMR (400 MHz, $CDCl_3$) 7.55 (d, *J* = 6.0 Hz, 6H), 7.51 (d, *J* = 7.6 Hz, 2H), 7.39 (d, *J* = 6.8 Hz, 8H), 7.31 (d, *J* = 6.8 Hz, 2H), 6.55 (d, *J* = 15.6 Hz, 1H), 6.41 (dd, *J* = 8.4 Hz, *J* =15.6 Hz, 1H), 4.38-4.33 (m, 1H), 4.02 (d, *J* = 10.8 Hz, 1H), 3.71 (s, 3H), 3.54 (s, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.1, 167.7, 140.5, 140.3, 139.9, 139.2, 135.8, 131.4, 129.0, 128.7, 128.5, 128.2, 128.1, 127.4, 127.2, 127.1, 126.9, 126.8, 126.8, 57.5, 52.6, 52.4, 48.8.



6e

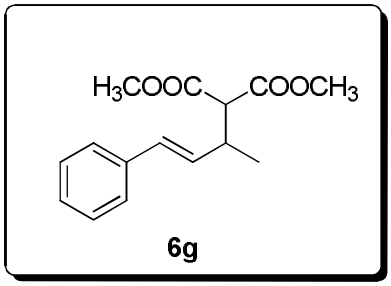
(E)-dimethyl 2-(1,3-bis(4-chlorophenyl)allyl)malonate 6e: light yellow oil. ^1H NMR (400 MHz, $CDCl_3$) 7.30-7.21 (m, 8H), 6.40 (d, *J* = 15.6 Hz, 1H), 6.26 (dd, *J* = 8.4 Hz, *J* =16.0 Hz, 1H), 4.24 (dd, *J* = 8.8 Hz, *J* =10.8 Hz, 1H), 3.90 (d, *J* = 10.8 Hz, 1H), 3.70 (s, 3H), 3.55 (s, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 167.9, 167.5, 138.5, 135.0, 133.4, 133.1, 131.0, 129.2, 129.2, 128.9, 128.7, 127.6, 57.3, 52.7, 52.6, 48.4. $C_{2o}H_{18}Cl_2O_4$: M+H = 393.0655. Found: 393.0646.



6f

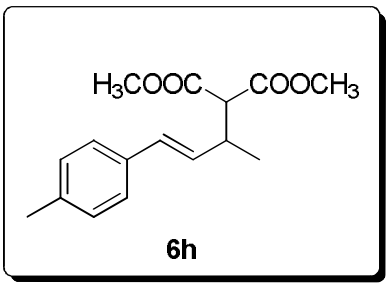
(E)-dimethyl 2-(1,3-bis(3-methoxyphenyl)allyl)malonate 6f: light yellow oil. ^1H NMR (400 MHz, $CDCl_3$) 7.24-7.16 (m, 2H), 6.92-6.87 (m, 2H), 6.84 (d, *J* = 2.0 Hz,

2H), 6.77-6.74 (m, 2H), 6.45 (d, J = 15.6 Hz, 1H), 6.30 (dd, J = 8.8 Hz, J = 15.6 Hz, 1H), 4.23 (dd, J = 8.8 Hz, J = 10.8 Hz, 1H), 3.95 (d, J = 10.8 Hz, 1H), 3.77 (d, J = 2.8 Hz, 6H), 3.69 (s, 3H), 3.54 (s, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.1, 167.6, 159.7, 159.7, 141.7, 138.2, 131.7, 129.6, 129.4, 129.2, 120.0, 119.0, 113.7, 113.1, 112.3, 111.7, 57.4, 55.1, 55.1, 52.5, 52.4, 49.1. HRMS (ESI) Calcd for $C_{22}H_{24}O_6$: M+H = 385.1646. Found: 385.1662.



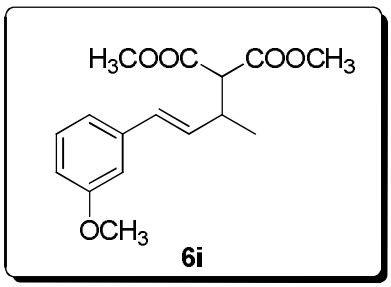
6g

(E)-dimethyl 2-(4-phenylbut-3-en-2-yl)malonate 6g: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.34-7.25 (m, 4H), 7.22-7.19 (m, 1H), 6.45 (d, J = 16.0 Hz, 1H), 6.12 (dd, J = 8.4 Hz, J = 15.6 Hz, 1H), 3.74 (s, 3H), 3.66 (s, 3H), 3.40 (d, J = 8.8 Hz, 1H), 3.17-3.08 (m, 1H), 1.90 (d, J = 6.8 Hz, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.6, 168.5, 137.0, 131.1, 130.8, 128.4, 127.3, 126.2, 57.7, 52.4, 52.3, 37.7, 18.4.



6h

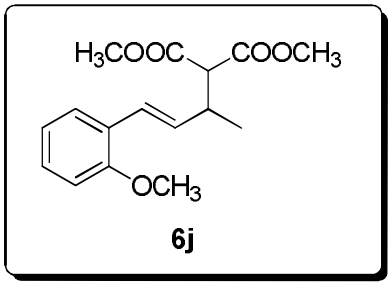
(E)-dimethyl 2-(4-(p-tolyl)but-3-en-2-yl)malonate 6h: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.22 (d, J = 8.0 Hz, 2H), 7.09 (d, J = 7.6 Hz, 2H), 6.42 (d, J = 16.0 Hz, 1H), 6.06 (dd, J = 8.4 Hz, J = 15.8 Hz, 1H), 3.74 (s, 3H), 3.66 (s, 3H), 3.39 (d, J = 9.2 Hz, 1H), 3.15-3.06 (m, 1H), 2.31 (s, 3H), 1.18 (d, J = 6.8 Hz, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.6, 168.6, 137.1, 134.3, 130.6, 130.1, 129.1, 126.1, 57.8, 52.3, 52.2, 37.7, 21.1, 18.4. HRMS (ESI) Calcd for $C_{16}H_{20}O_4$: M+Na = 299.1254. Found: 299.1258.



6i

(E)-dimethyl 2-(4-(3-methoxyphenyl)but-3-en-2-yl)malonate 6i : light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.22-7.18(m, 1H), 6.92 (d, J = 7.6 Hz, 1H), 6.87-6.86 (m, 1H), 6.77 (dd, J = 2.4 Hz, J = 8.0 Hz, 1H), 6.42 (d, J = 16.0 Hz, 1H), 6.12 (dd, J = 8.4 Hz, J = 15.6 Hz, 1H), 3.80 (s, 3H), 3.74 (s, 3H), 3.67 (s, 3H), 3.40 (d, J = 8.4 Hz, 1H), 3.17-3.07 (m, 1H), 1.19 (d, J = 6.8 Hz, 1H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.5,

168.5, 159.7, 138.5, 131.4, 130.7, 129.4, 118.8, 112.9, 111.6, 57.7, 55.1, 52.3, 52.3, 37.6, 18.4. HRMS (ESI) Calcd for $C_{16}H_{20}O_5$: M+H = 293.1384. Found: 293.1380.



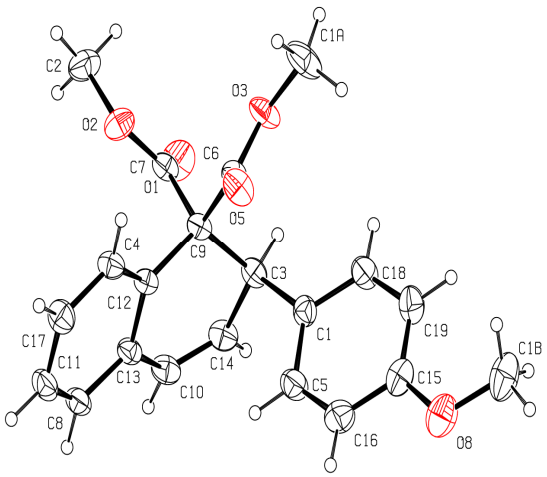
6j

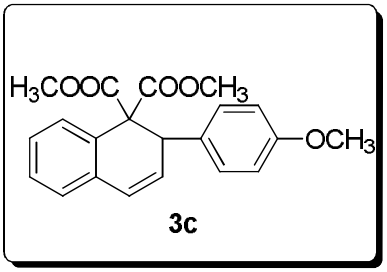
(E)-dimethyl 2-(4-(2-methoxyphenyl)but-3-en-2-yl)malonate 6j: light yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) 7.37 (dd, J = 2.0 Hz, J = 8.0 Hz, 1H), 7.21-7.17 (m, 1H), 6.91-6.87 (m, 1H), 6.84-6.76 (m, 2H), 6.10 (dd, J = 8.4 Hz, J = 16.0 Hz, 1H), 3.82 (s, 3H), 3.74 (s, 3H), 3.67 (s, 3H), 3.41 (d, J = 8.8 Hz, 1H), 3.18-3.09 (m, 1H), 1.20 (d, J = 6.4 Hz, 3H). ^{13}C NMR (400 MHz, $CDCl_3$) 168.7, 168.6, 156.5, 131.6, 128.4, 126.6, 126.2, 125.5, 120.5, 110.7, 57.9, 55.3, 52.3, 52.2, 38.0, 18.5. HRMS (ESI) Calcd for $C_{16}H_{20}O_5$: M+H = 293.1384. Found: 293.1391.

7. References

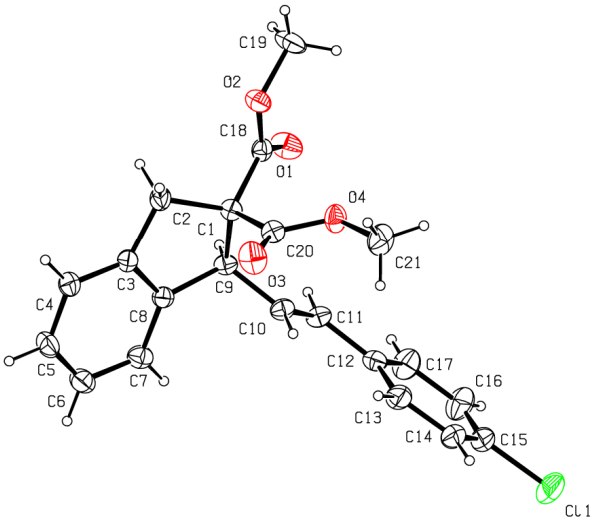
1) D. Zhang, E. K. Yum, Z. Liu and R. C. Larock, *Org. Lett*, 2005, **7**, 4963.
2) P.-X. Zhou, J.-Y. Luo, L.-B. Zhao, Y.-Y. Ye and Y.-M. Liang, *Chem. Commun*, 2013, **49**, 3252.
3) H.-P. Bi, L.-N. Guo, X.-H. Duan, F.-R. Gou, S.-H. Huang, X.-Y. Liu and Y.-M. Liang, *Org. Lett*, 2007, **9**, 397.
4) R. Šebesta, A. Škvorcová and B. Horváth, *Tetrahedron: Asymmetry*, 2010, **21**, 1910.

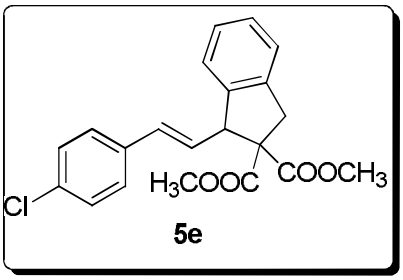
8. The crystal structure of product 3c and 5e





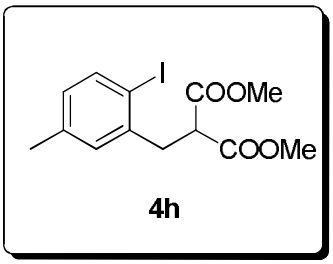
3c





5e

9. ^{1}H NMR and ^{13}C NMR Spectra for Products


I
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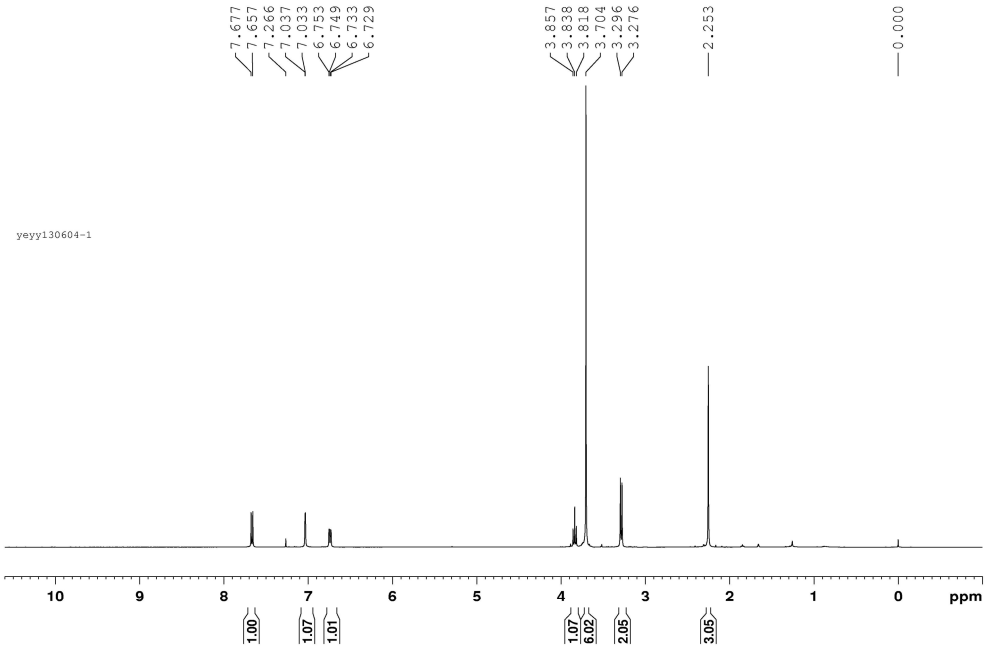
COOMe

4h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7.266
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6.753
6.749
6.733
6.729
3.857
3.838
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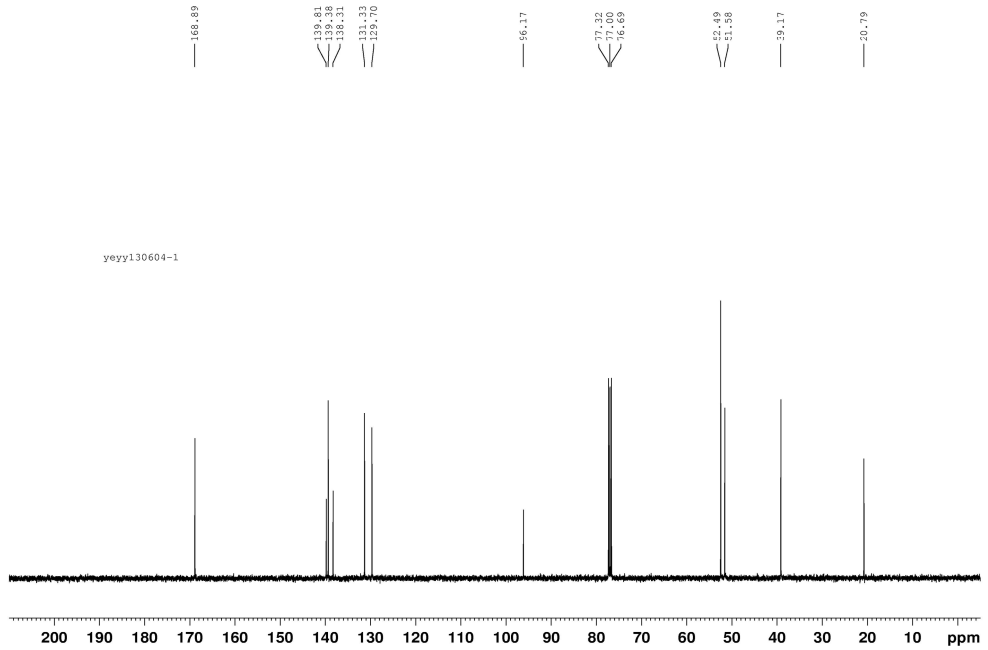
3.704
3.296
3.276
2.253
0.000
yeyy130604-1
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.07
1.01
1.07
6.02
2.05
3.05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138.31
131.33
129.70
56.17
77.32
77.00
76.69
52.49
51.58
39.17
20.79
yeyy130604-1
200
190
180
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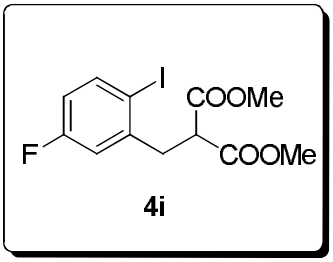
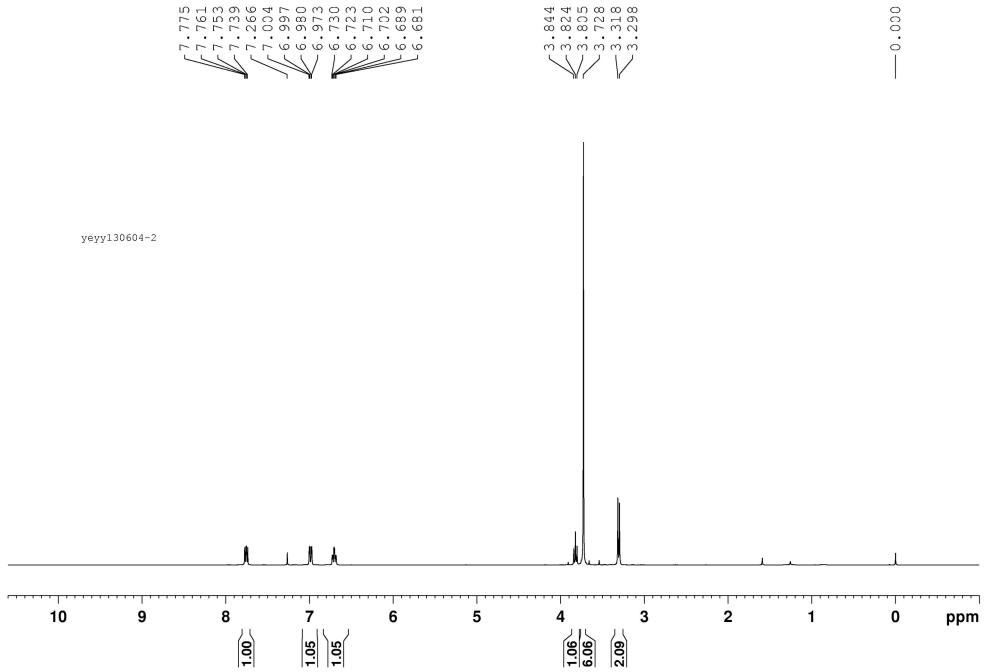
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


I
COOMe
F
COOMe

4i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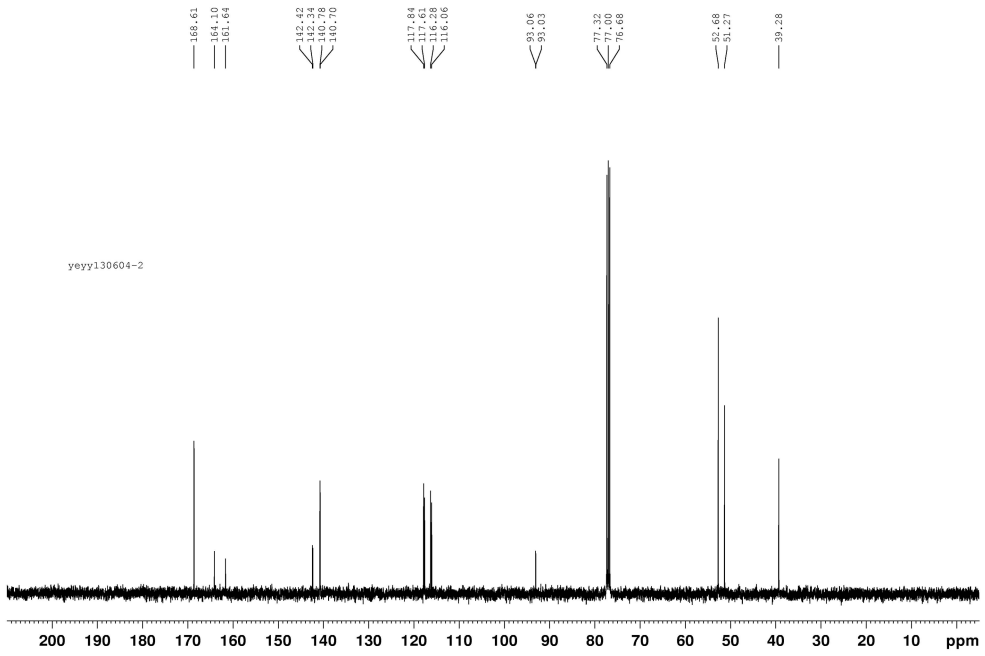
7.761
7.753
7.739
7.266
7.004
6.997
6.980
6.973
6.730
6.723
6.710
6.702
6.689
6.681
3.844
3.824
3.805
3.728
3.318
3.298
0.000
yeyy130604-2
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.05
1.05
1.06
6.06
2.09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164.10
161.64
142.42
142.34
140.78
140.70
117.84
117.61
116.28
116.06
93.06
93.03
77.32
77.00
76.68
52.68
51.27
39.28
yeyy130604-2
200
190
180
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150
140
130
120
110
100
90
80
70
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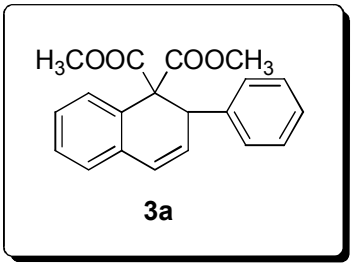
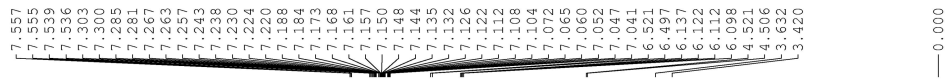
40
30
20
10
ppm


H3COOC
COOCH3

3a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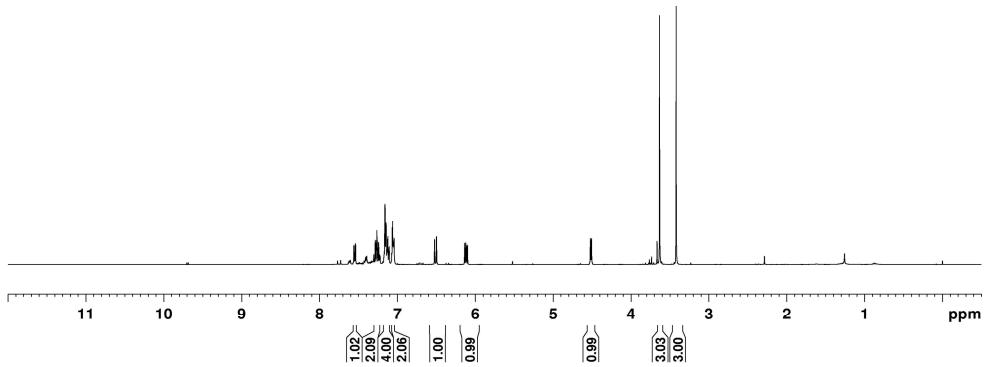
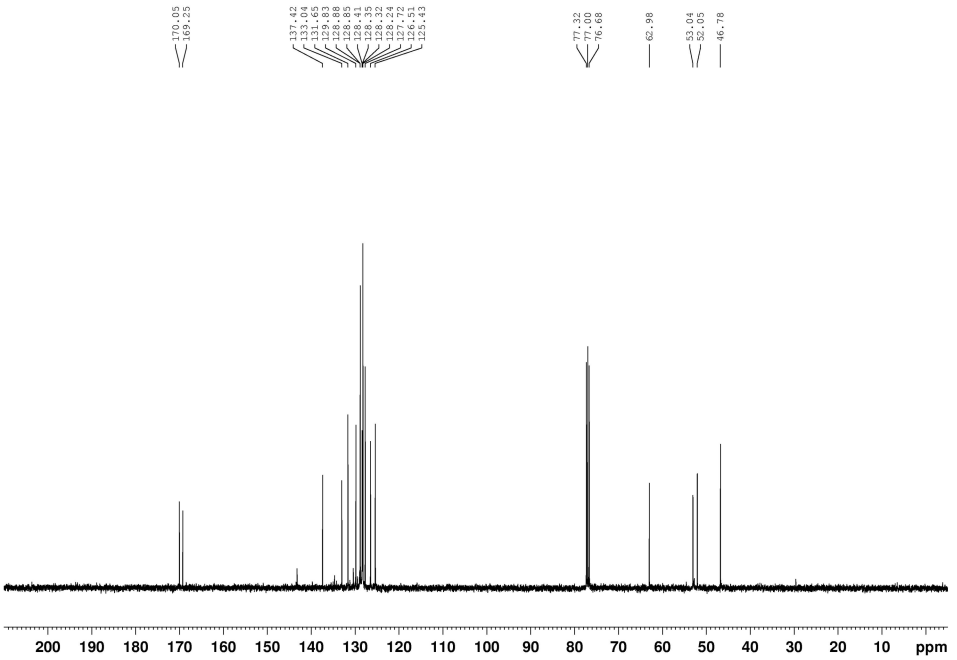
7.555
7.539
7.536
7.303
7.300
7.285
7.281
7.267
7.263
7.257
7.243
7.238
7.230
7.224
7.220
7.188
7.184
7.173
7.168
7.161
7.157
7.150
7.148
7.144
7.135
7.132
7.126
7.122
7.112
7.108
7.104
7.072
7.065
7.060
7.052
7.047
7.041
6.521
6.497
6.137
6.122
6.112
6.098
4.521
4.506
3.632
3.420
0.000


11
10
9
8
7
6
5
4
3
2
1
ppm
1.02
2.09
4.00
2.06
1.00
0.99
0.99
3.03
3.00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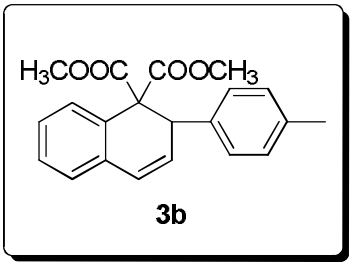
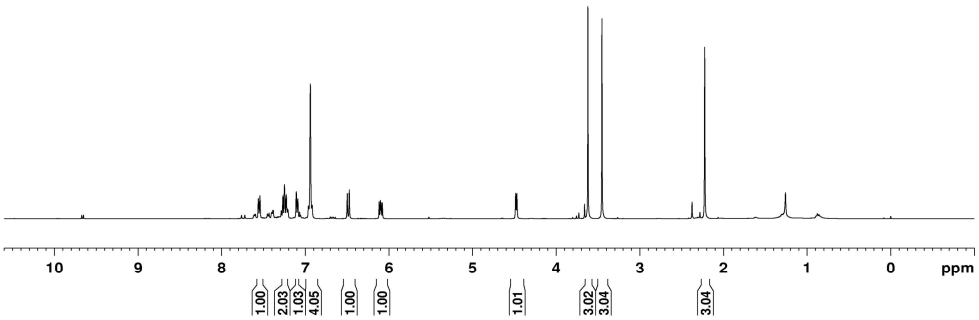
169.25
137.42
134.04
131.60
129.83
128.88
128.65
128.41
128.35
128.32
128.24
127.72
126.51
125.43
77.32
77.00
76.68
62.98
53.04
52.05
46.78
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

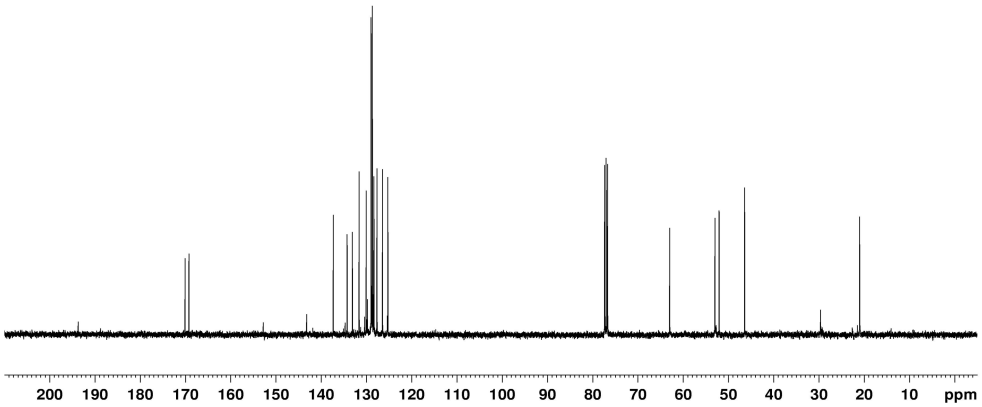


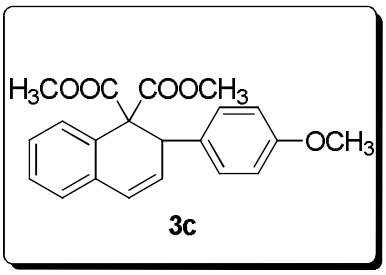
3b

yeyy130417-chanwu5

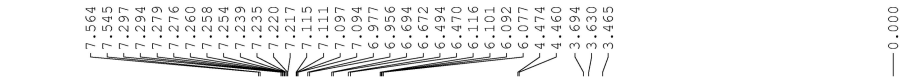


yeyy130417-chanwu5

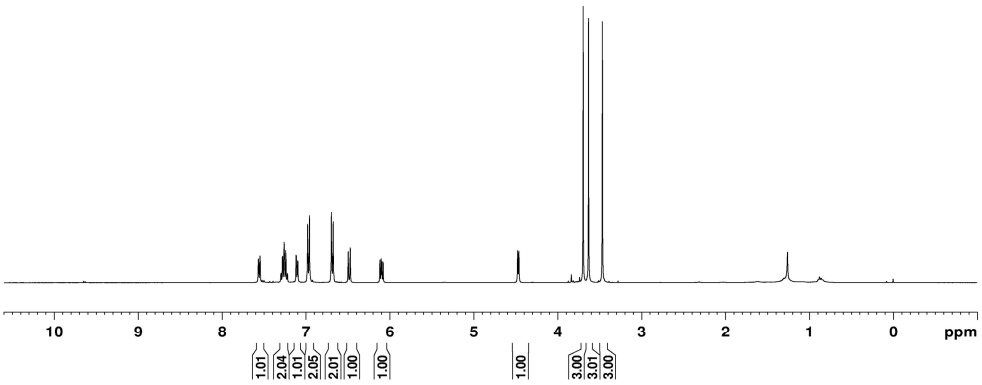


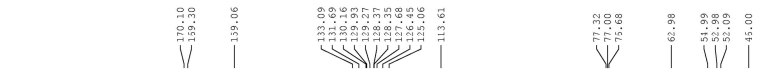


3c

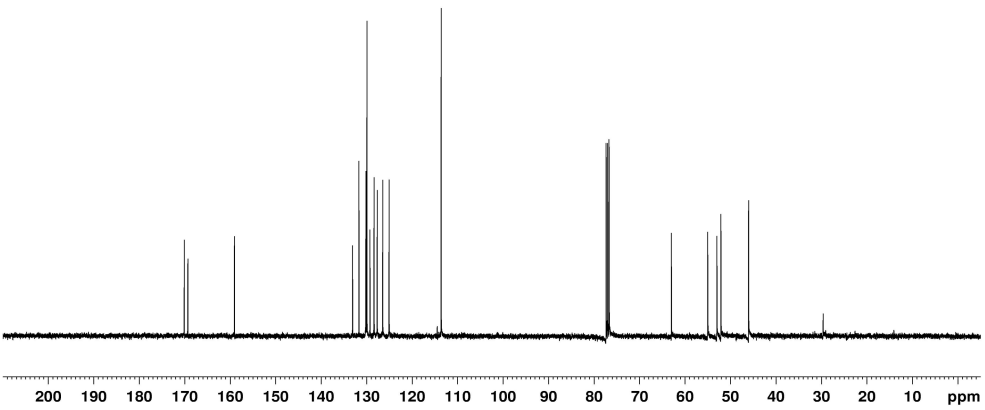


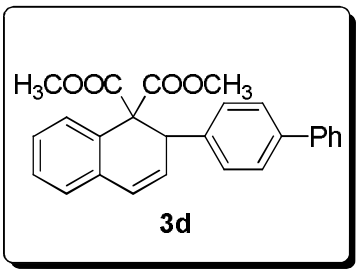
yeyy130417-chanwu4



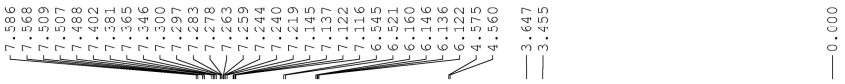


yeyy130417-chanwu4

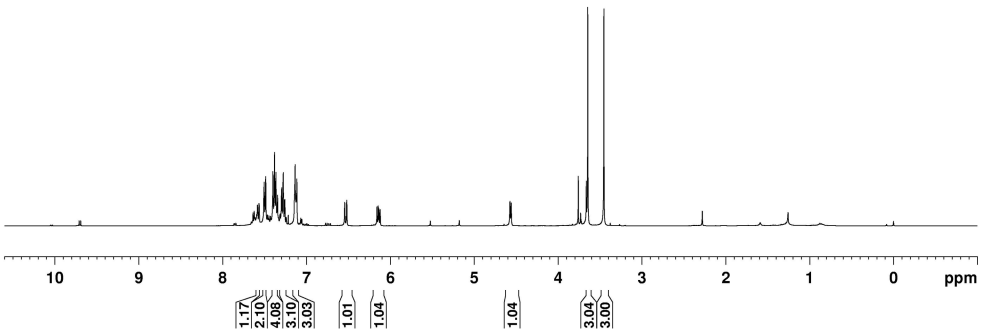


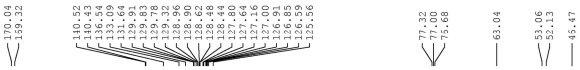


3d

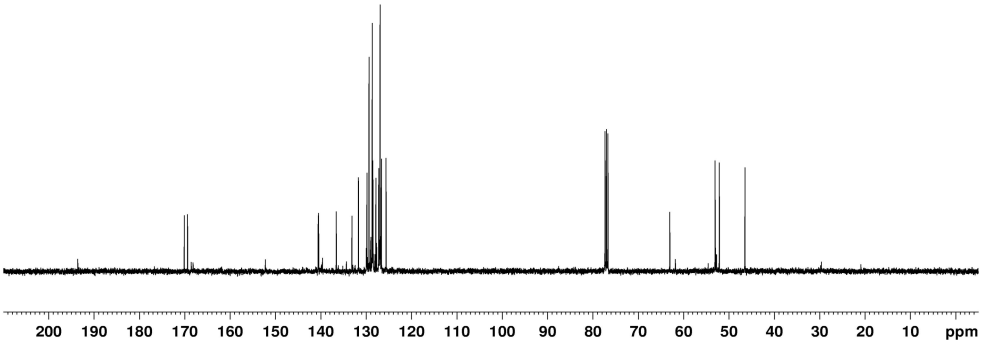


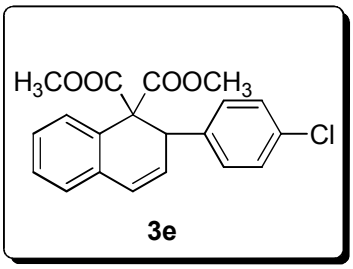
yeyy130525-cw2



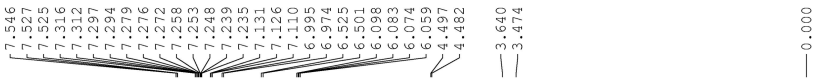


yeyy130525-cw23




H3COOC
COOCH3
Cl

3e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7.316
7.312
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7.279
7.276
7.272
7.258
7.253
7.248
7.239
7.235
7.131
7.126
7.110
6.995
6.974
6.525
6.501
6.098
6.083
6.074
6.059
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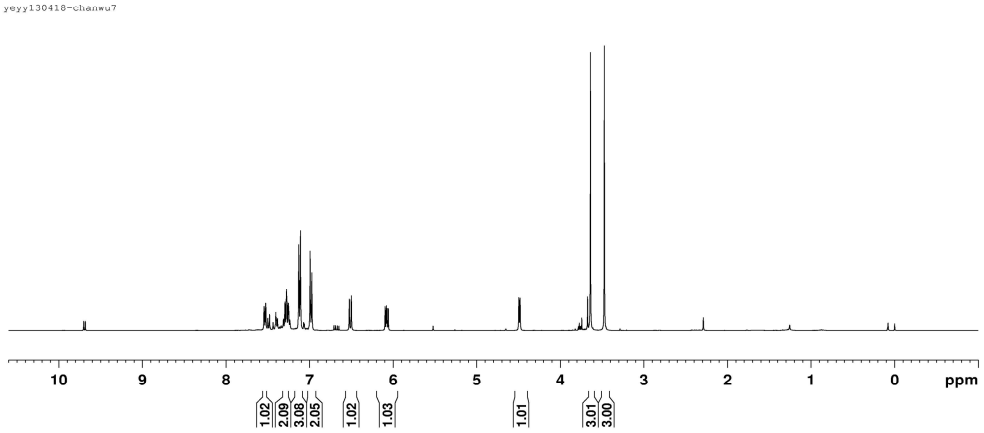
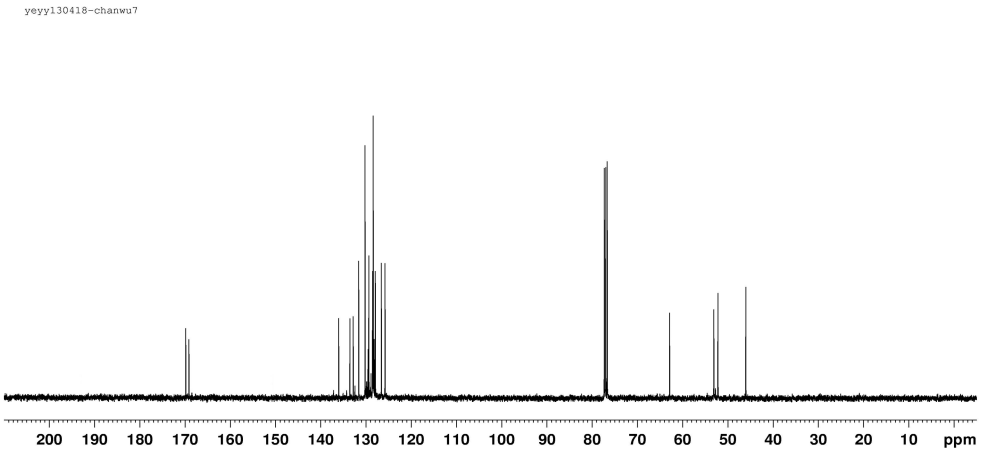
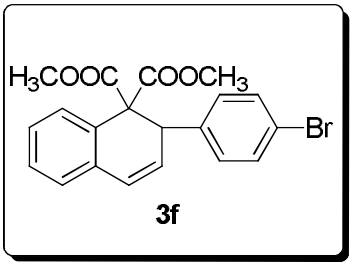
4.482
3.640
3.474
0.000

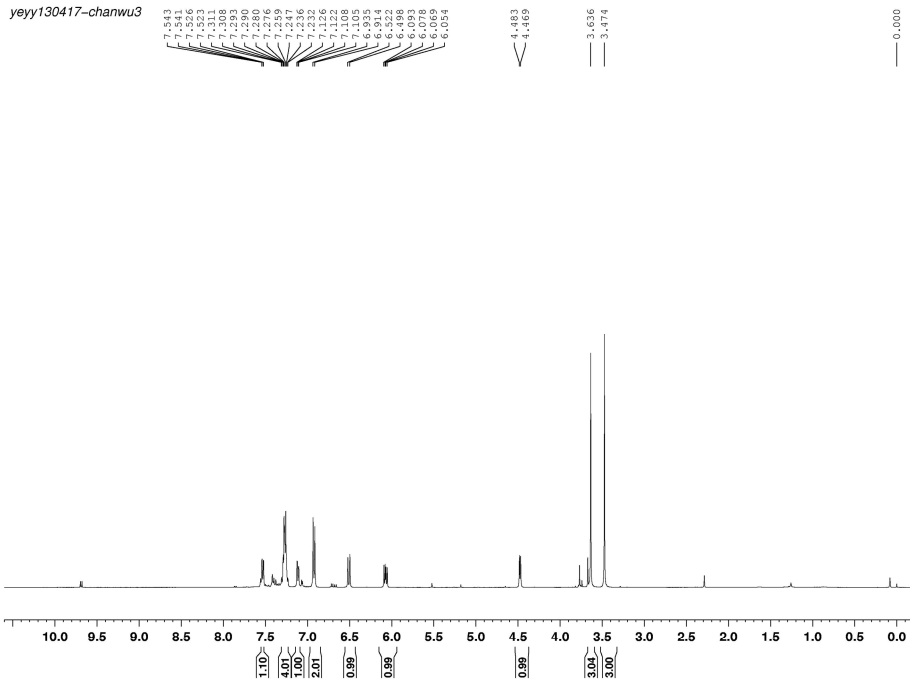

yeyy130418-chanwu7
10
9
8
7
6
5
4
3
2
1
0
ppm
1.02
2.09
3.08
2.05
1.02
1.03
1.01
3.01
3.00

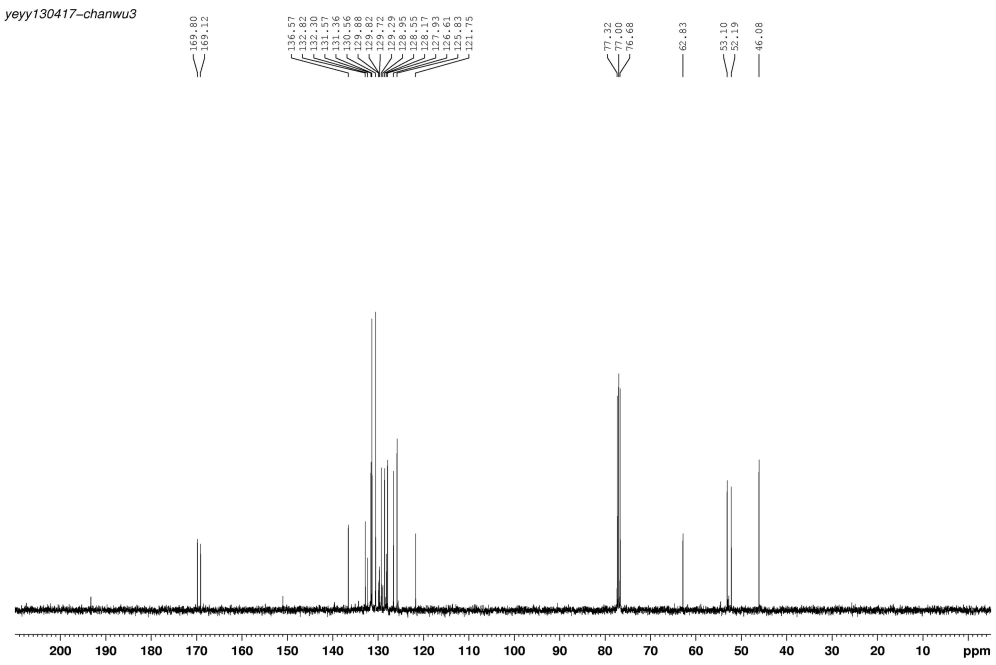

169.85
169.15
136.05
133.37
132.84
131.61
130.22
129.56
129.38
129.35
128.89
128.56
128.42
128.19
127.98
126.62
125.81
77.31
77.00
76.68
62.90
53.11
52.20
46.03

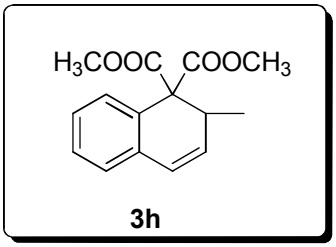

yeyy130418-chanwu7
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


H3COOC
COOCH3
Br

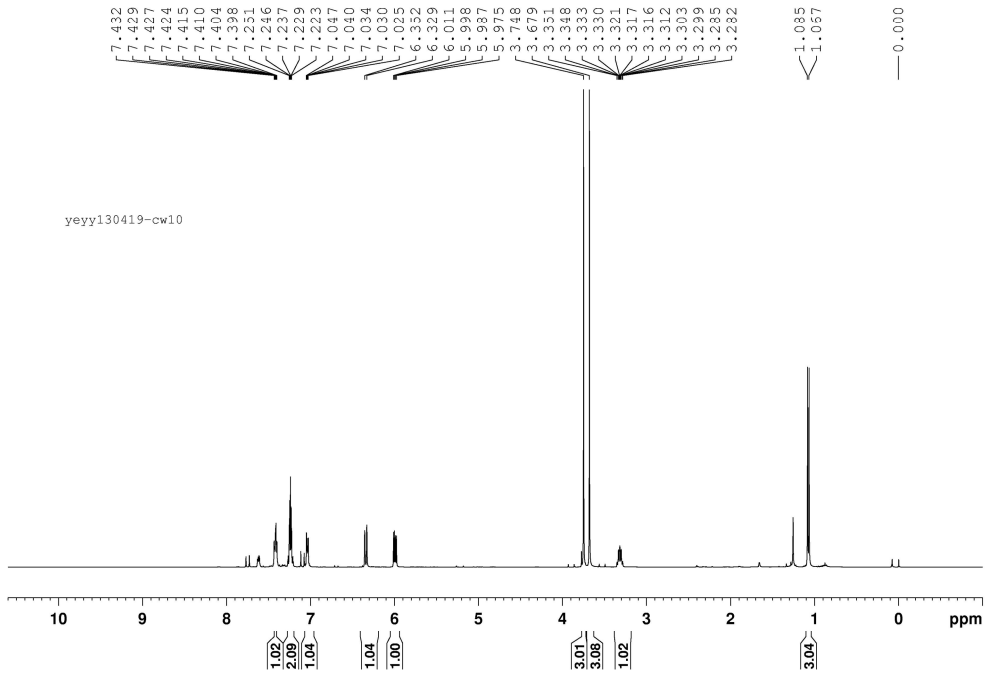
3f


yeyy130417-chanwu3
7.543
7.541
7.526
7.523
7.311
7.308
7.293
7.290
7.280
7.276
7.259
7.247
7.236
7.232
7.126
7.122
7.108
7.105
6.935
6.914
6.522
6.498
6.093
6.078
6.069
6.054
4.483
4.469
3.636
3.474
0.000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.10
4.01
1.00
2.01
0.99
0.99
0.99
3.04
3.00


yeyy130417-chanwu3
169.80
169.12
136.57
132.82
132.30
131.37
131.36
130.56
129.88
129.82
129.72
129.39
128.95
128.55
128.17
127.93
126.61
125.83
121.75
77.32
77.00
76.68
62.83
53.10
52.19
46.08
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


H3COOC
COOCH3

3h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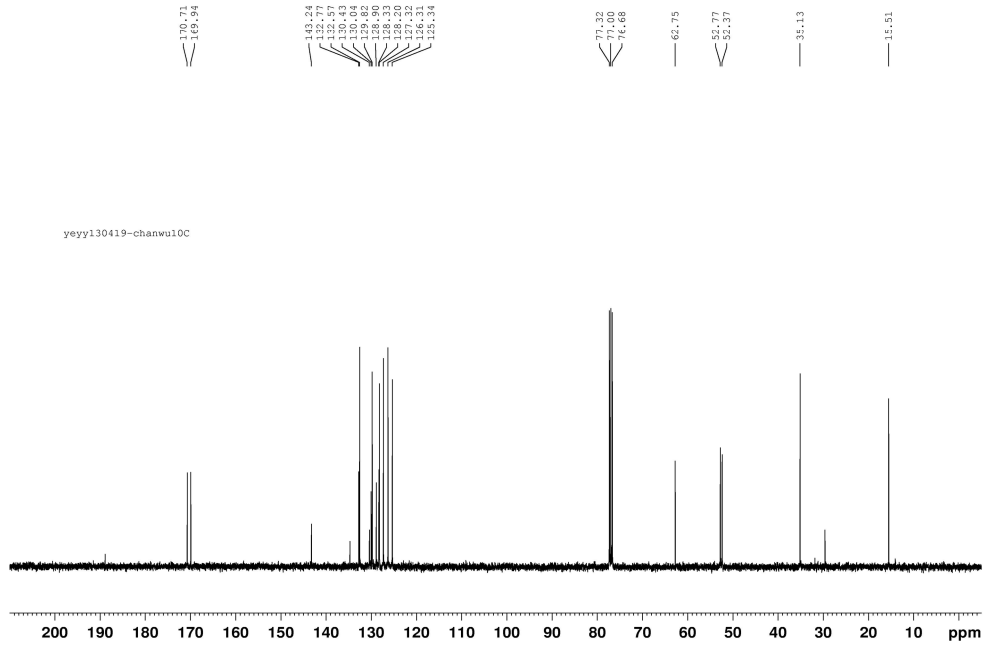
7.415
7.410
7.404
7.398
7.251
7.246
7.237
7.229
7.223
7.047
7.040
7.034
7.030
7.025
6.332
6.329
6.011
5.998
5.987
5.975
3.748
3.679
3.351
3.348
3.333
3.330
3.321
3.317
3.316
3.312
3.303
3.299
3.285
3.282
1.085
1.057
0.000
yeyy130419-cw10
10
9
8
7
6
5
4
3
2
1
0
ppm
1.02
2.09
1.04
1.04
1.00
3.01
3.08
1.02
3.04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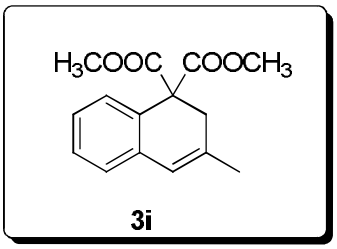
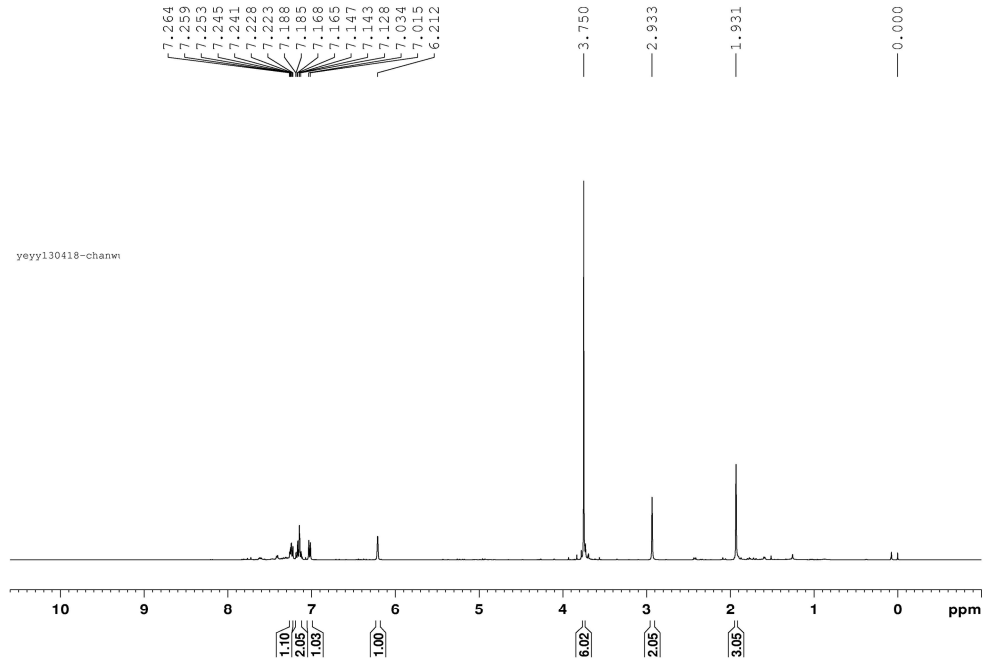
132.77
132.57
130.43
130.04
129.82
128.90
128.33
128.20
127.32
126.31
125.34
77.32
77.00
76.68
62.75
52.77
52.37
35.13
15.51
yeyy130419-chanwu10C
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


H3COOC
COOCH3

3i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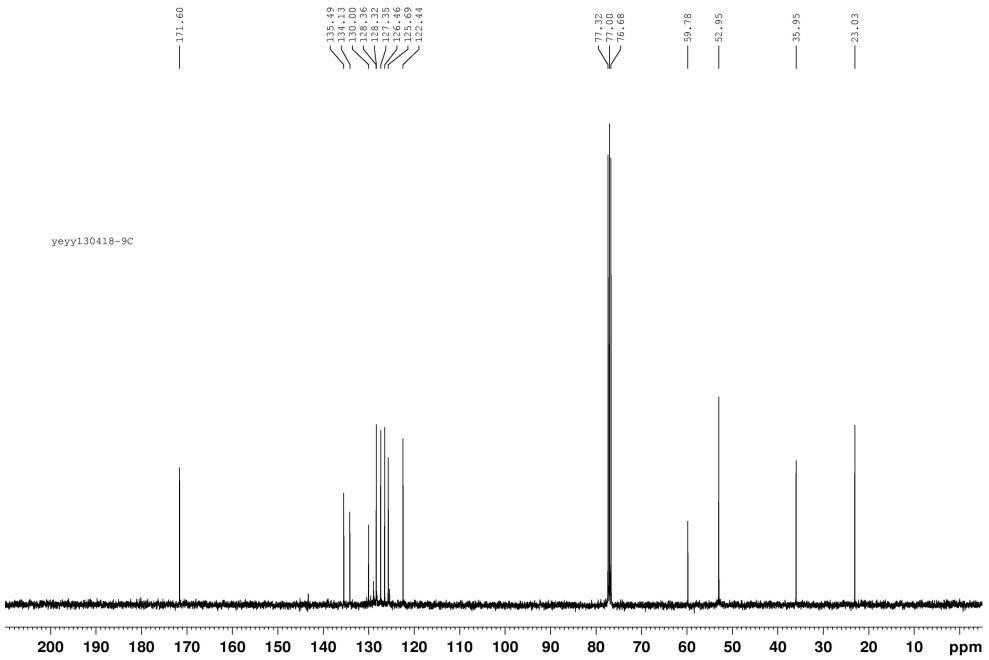
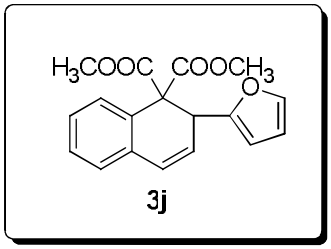
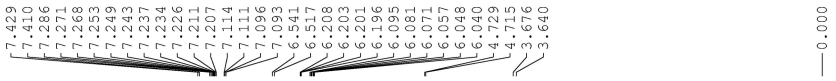
7.223
7.188
7.185
7.168
7.165
7.147
7.143
7.128
7.034
7.015
6.212
3.750
2.933
1.931
0.000
yeyy130418-chanwe
10
9
8
7
6
5
4
3
2
1
0
ppm
1.10
2.05
1.09
1.00
6.02
2.05
3.05


171.60
135.49
134.13
130.00
128.36
128.32
127.38
126.46
125.69
122.44
77.32
77.00
76.68
59.78
52.95
35.95
23.03
yeyy130418-9C
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


H3COOC
COOCH3
O

3j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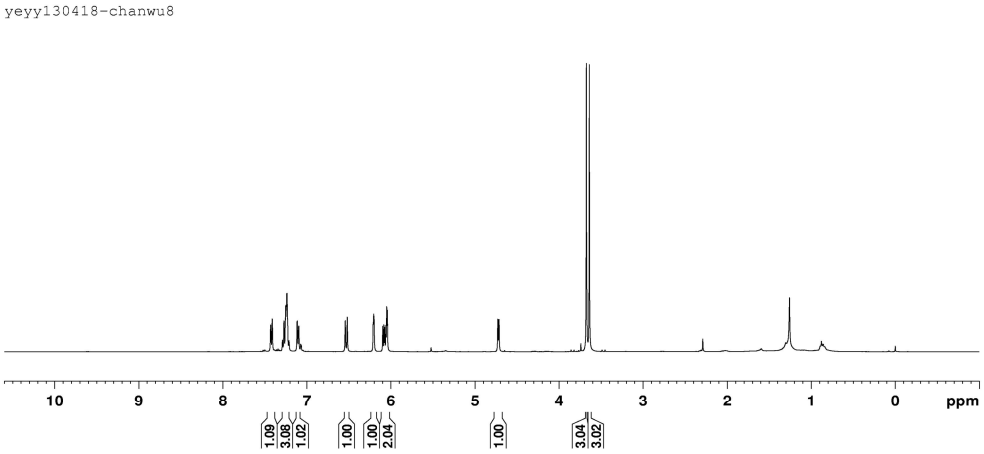
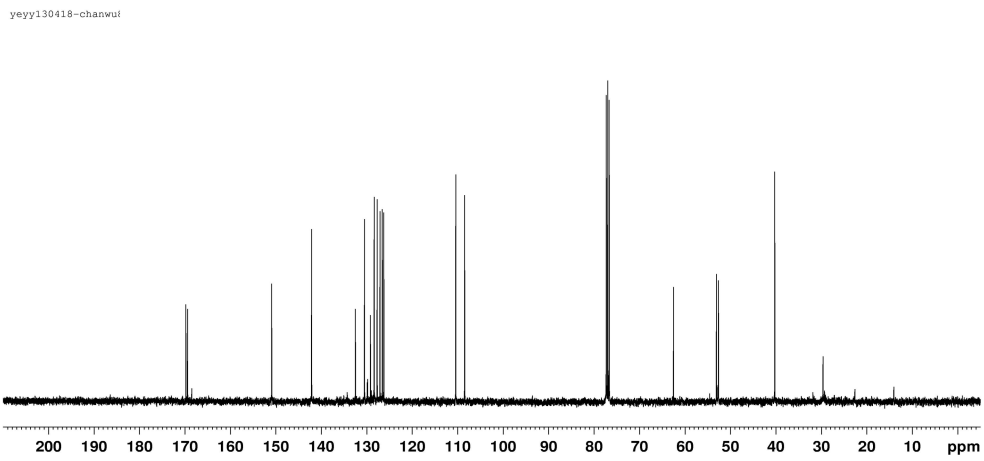
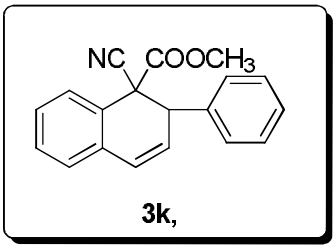
7.271
7.268
7.253
7.249
7.243
7.237
7.234
7.226
7.211
7.207
7.114
7.111
7.096
7.093
6.541
6.517
6.208
6.203
6.201
6.196
6.095
6.081
6.071
6.057
6.048
6.040
4.729
4.715
3.676
3.640
0.000

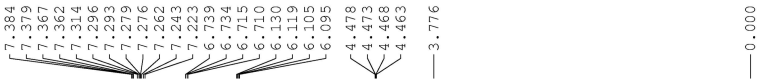

yeyy130418-chanwu8
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
3.08
1.02
1.00
1.00
2.04
1.00
3.04
3.02


169.82
169.43
150.95
142.16
132.53
130.52
128.22
128.39
127.73
127.11
126.61
126.27
110.43
108.49
77.32
77.00
76.68
62.51
53.08
52.64
40.25


yeyy130418-chanwu
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


NC
COOCH3

3k,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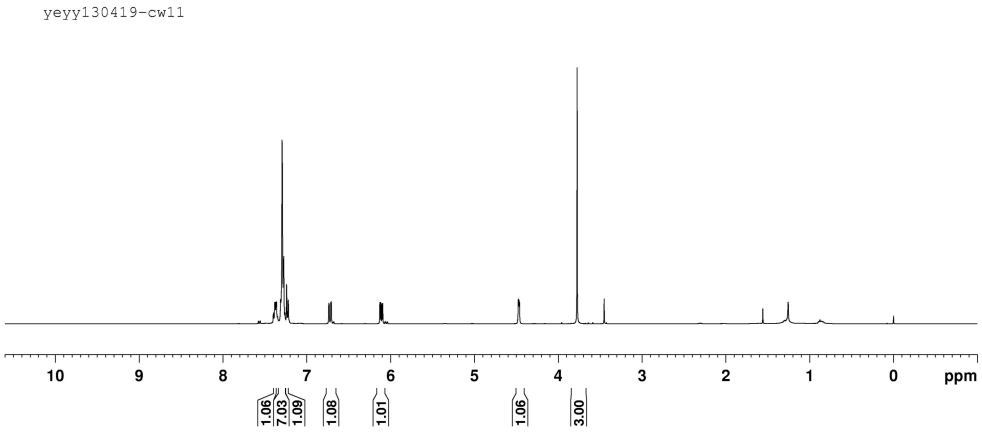
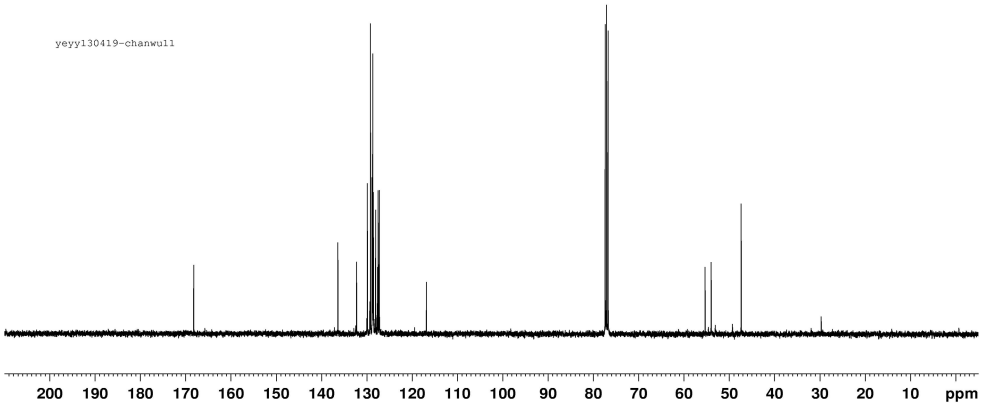
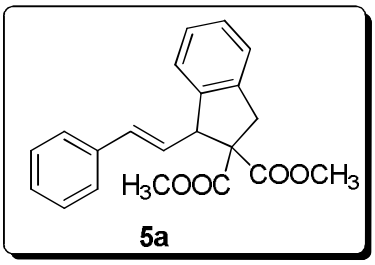
7.379
7.367
7.362
7.314
7.296
7.293
7.279
7.276
7.262
7.243
7.223
6.739
6.734
6.715
6.710
6.130
6.119
6.105
6.095
4.478
4.473
4.468
4.463
3.776
0.000

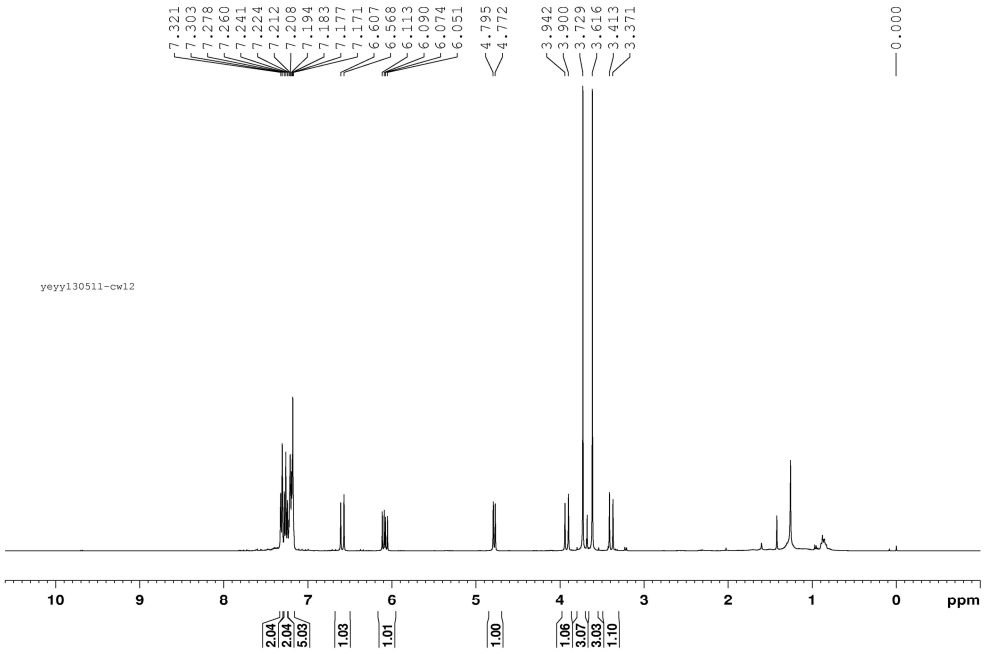

yeyy130419-cw11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.06
7.03
1.09
1.08
1.01
1.06
3.00


168.16
136.32
132.21
129.83
129.13
128.78
128.72
128.64
128.60
128.49
128.00
127.58
127.43
127.18
126.78
77.32
77.00
76.68
55.28
53.93
47.31


yeyy130419-chanwu11
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


H3COOC
COOCH3

5a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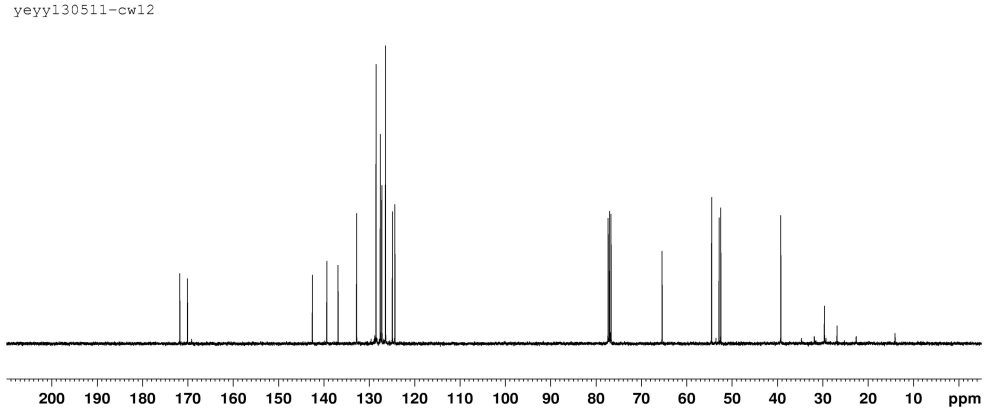
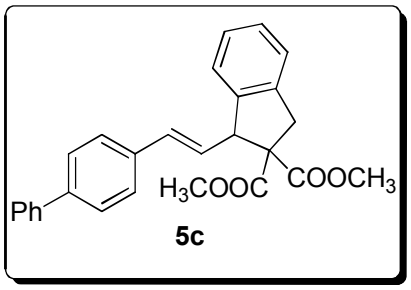
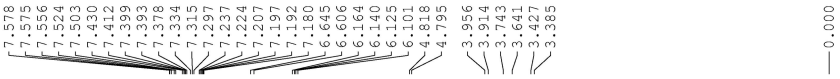
7.303
7.278
7.260
7.241
7.224
7.212
7.208
7.194
7.183
7.177
7.171
6.607
6.568
6.113
6.090
6.074
6.051
4.795
4.772
3.942
3.900
3.729
3.616
3.413
3.371
0.000
yeyy130511-cw12
10
9
8
7
6
5
4
3
2
1
0
ppm
2.04
2.04
5.09
1.03
1.01
1.00
1.06
3.07
3.03
1.10

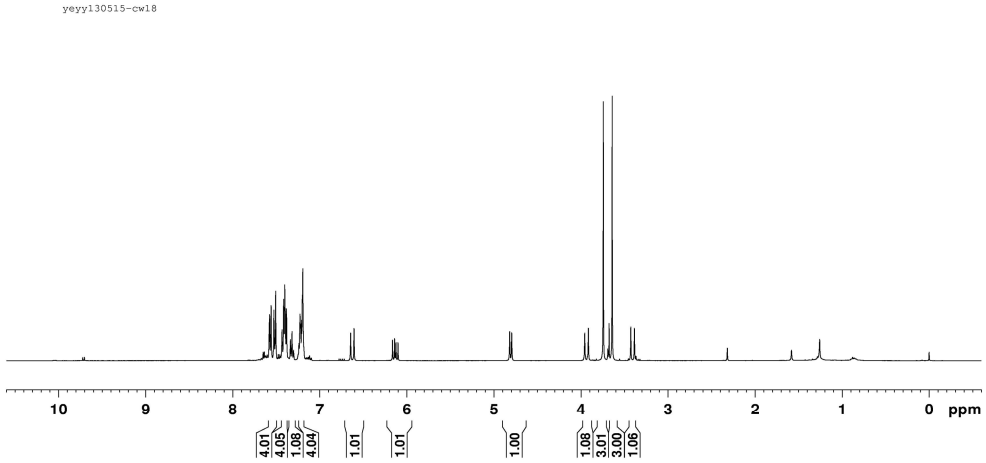

171.72
170.03
142.47
139.29
136.82
132.72
128.45
127.65
127.16
126.35
124.83
124.28
77.32
77.00
76.68
65.43
54.49
53.85
52.48
39.24


yeyy130511-cw12
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

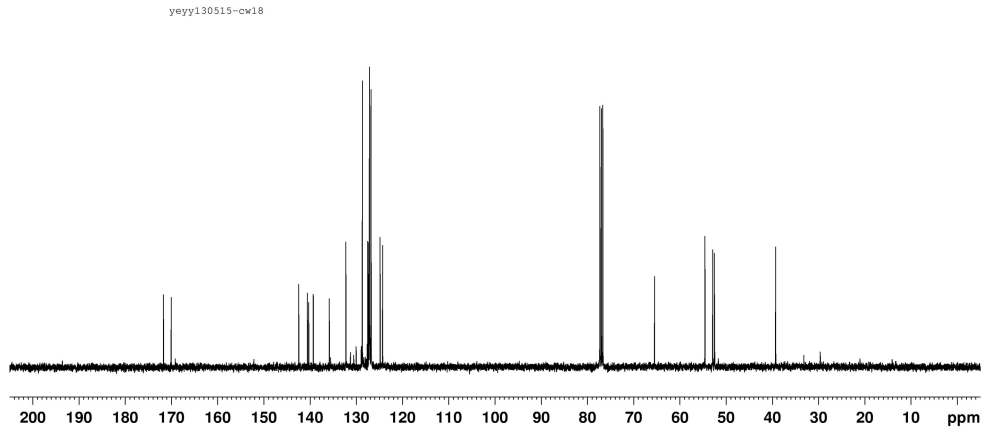

Ph
H3COOC
COOCH3

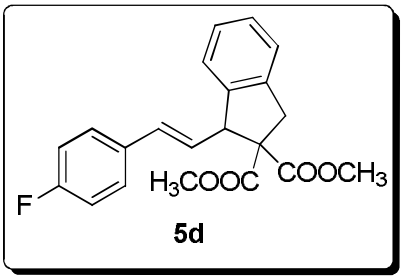
5c


7.578
7.575
7.556
7.524
7.503
7.430
7.412
7.399
7.393
7.378
7.334
7.315
7.297
7.237
7.224
7.207
7.197
7.192
7.180
6.645
6.606
6.164
6.140
6.125
6.101
4.818
4.795
3.956
3.914
3.743
3.641
3.427
3.385
0.000


yeyy130515-cw18
10
9
8
7
6
5
4
3
2
1
0
ppm
4.01
4.05
1.08
4.04
1.01
1.01
1.00
1.08
3.01
3.00
1.06

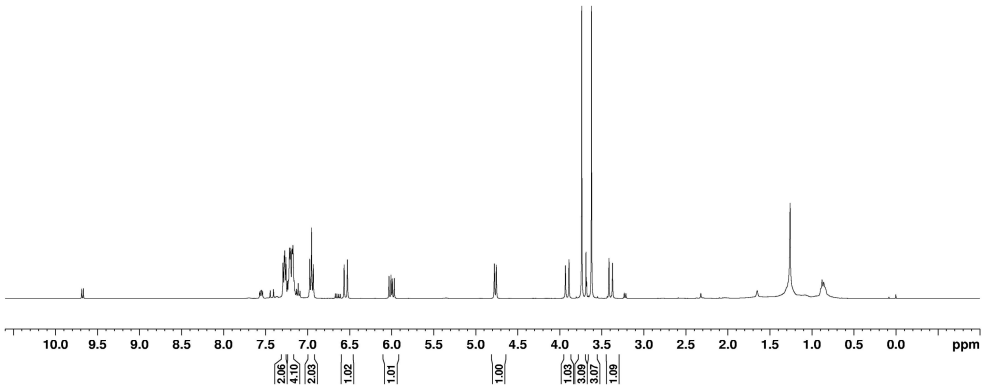

171.76
170.07
142.48
140.60
140.31
139.33
135.87
132.27
128.72
127.55
127.32
127.25
127.20
127.16
127.03
126.85
126.80
124.87
124.33
77.31
77.00
75.68
65.50
54.58
52.90
52.55
39.28


yeyy130515-cw18
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

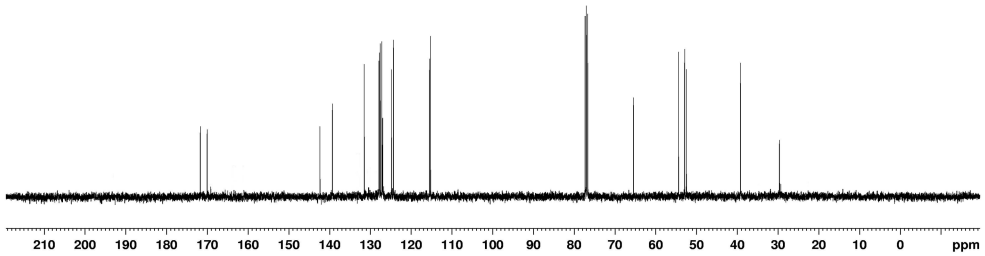


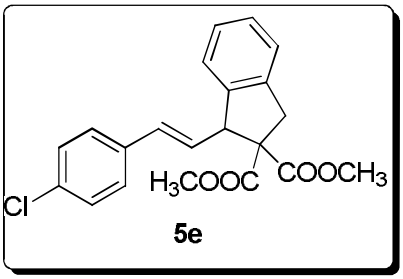
5d

yeyy130514-cw14

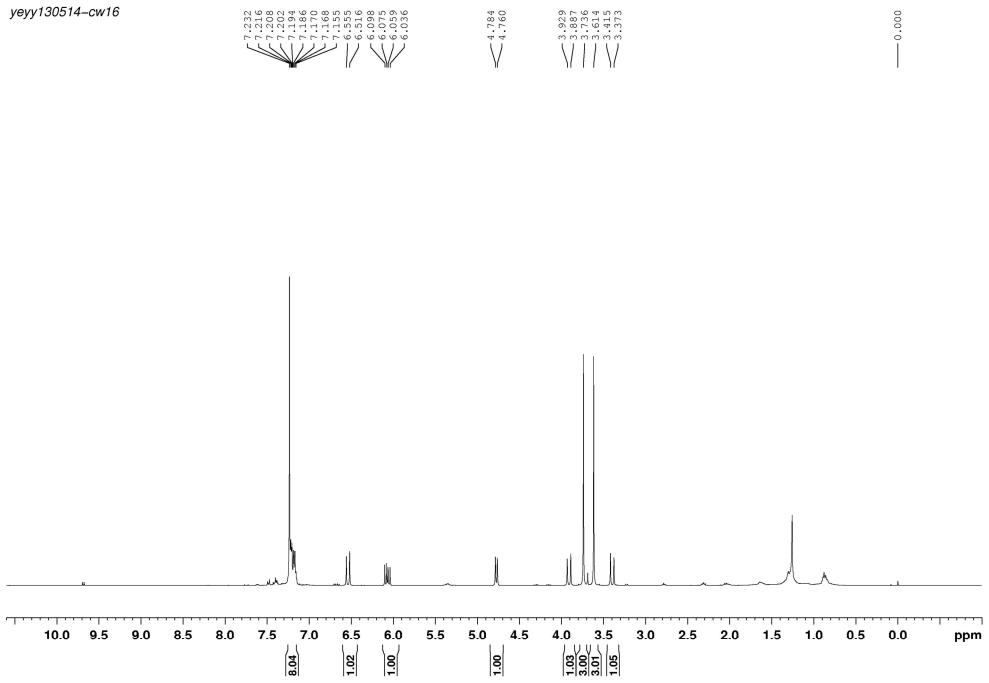


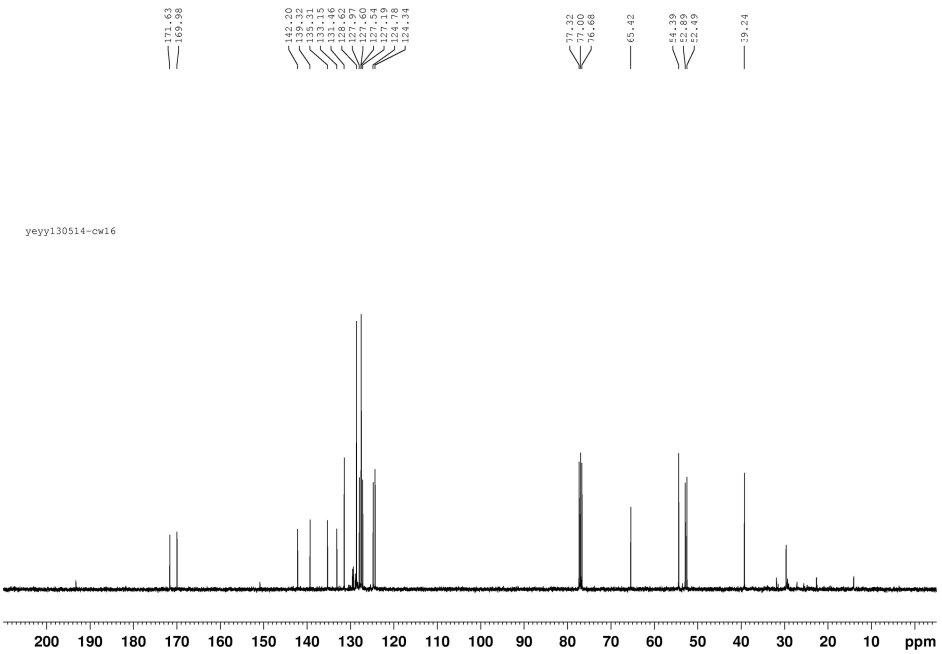
yeyy130514-cw14

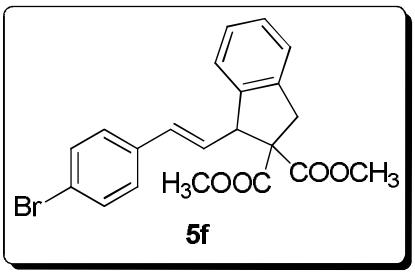



Cl
H3COOC
COOCH3

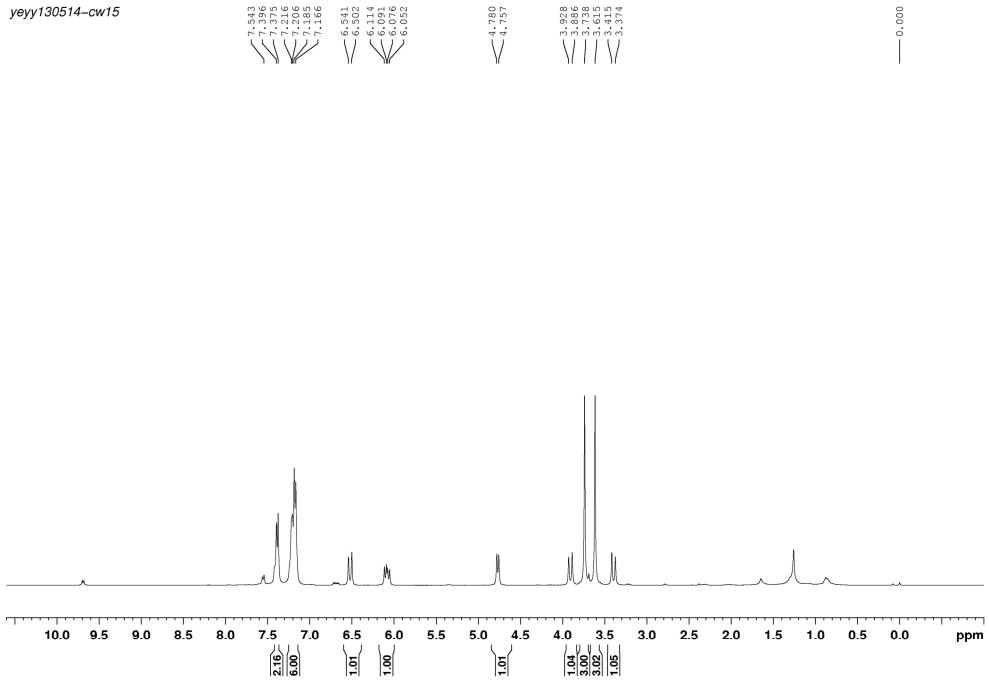
5e

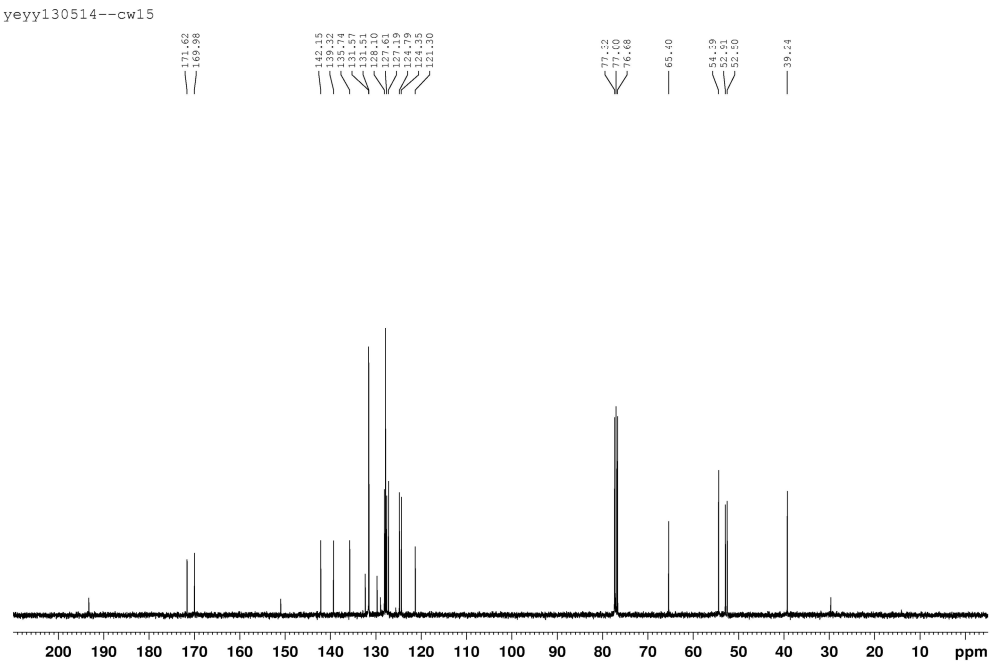

yeyy130514-cw16
7.232
7.216
7.208
7.202
7.194
7.186
7.170
7.168
7.155
6.555
6.516
6.098
6.075
6.059
6.036
4.784
4.760
3.929
3.887
3.736
3.654
3.415
3.373
0.000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
8.04
1.02
1.00
1.00
1.03
3.00
3.07
1.05

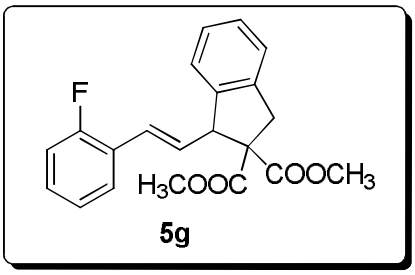

171.63
169.98
142.20
139.32
135.31
133.15
131.46
128.62
127.97
127.60
127.54
127.19
124.78
124.34
77.32
77.00
76.68
65.42
54.39
52.89
52.49
39.24
yeyy130514-cw16
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


Br
H3COOC
COOCH3

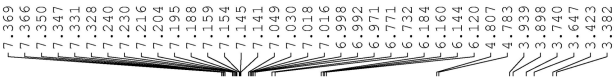
5f

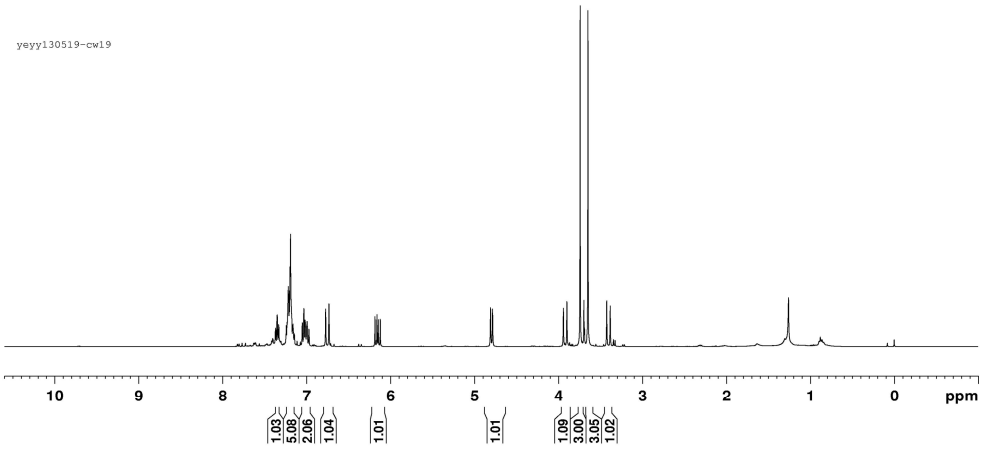

yeyy130514-cw15
7.543
7.396
7.375
7.216
7.206
7.185
7.166
6.541
6.502
6.114
6.091
6.076
6.052
4.780
4.757
3.928
3.886
3.738
3.615
3.415
3.374
0.000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
2.16
6.00
1.01
1.00
1.01
1.04
3.00
3.02
1.05

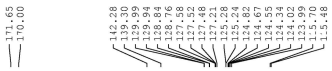

yeyy130514--cw15
171.62
169.98
142.15
139.32
135.74
131.57
131.11
128.10
127.61
127.19
124.79
124.35
121.30
77.32
77.00
76.68
65.40
54.39
52.91
52.50
39.24
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


F
H3COOC
COOCH3

5g

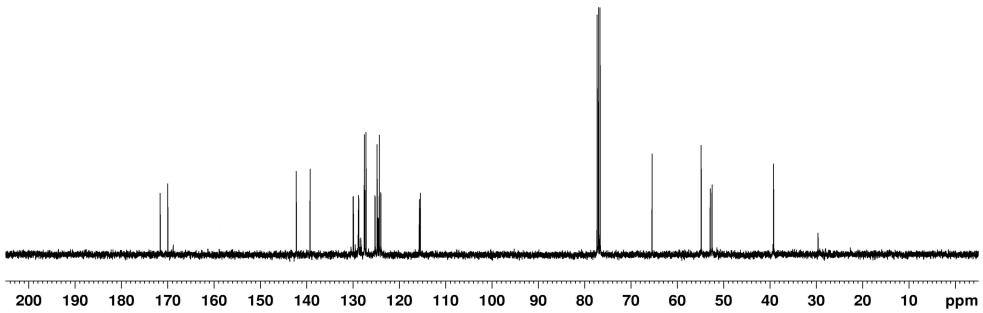

7.369
7.366
7.350
7.347
7.331
7.328
7.240
7.230
7.216
7.204
7.195
7.188
7.159
7.154
7.145
7.141
7.049
7.030
7.018
7.016
6.998
6.992
6.971
6.771
6.732
6.184
6.160
6.144
6.120
4.807
4.783
3.939
3.898
3.740
3.647
3.423
3.382
0.000

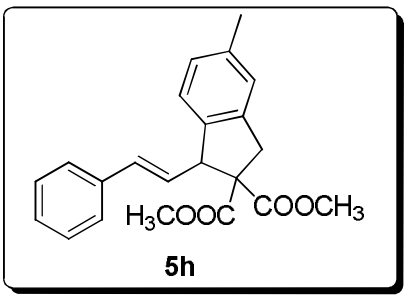

yeyy130519-cw19
10
9
8
7
6
5
4
3
2
1
0
ppm
1.03
5.06
2.06
1.04
1.01
1.01
1.00
3.00
3.05
1.02


171.65
170.00

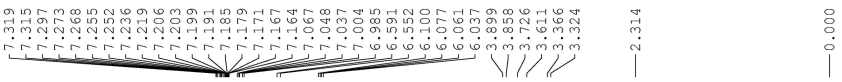
142.28
139.30
139.09
129.94
128.84
128.76
127.58
127.32
127.48
127.21
125.28
125.24
124.82
124.67
124.55
124.34
124.00
123.99
115.70
115.48

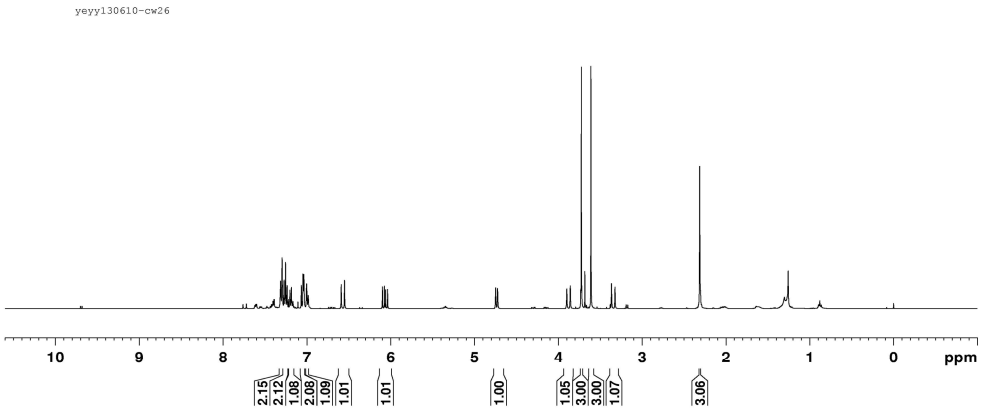

77.32
77.00
76.68
65.45
54.85
52.90
52.51
39.23

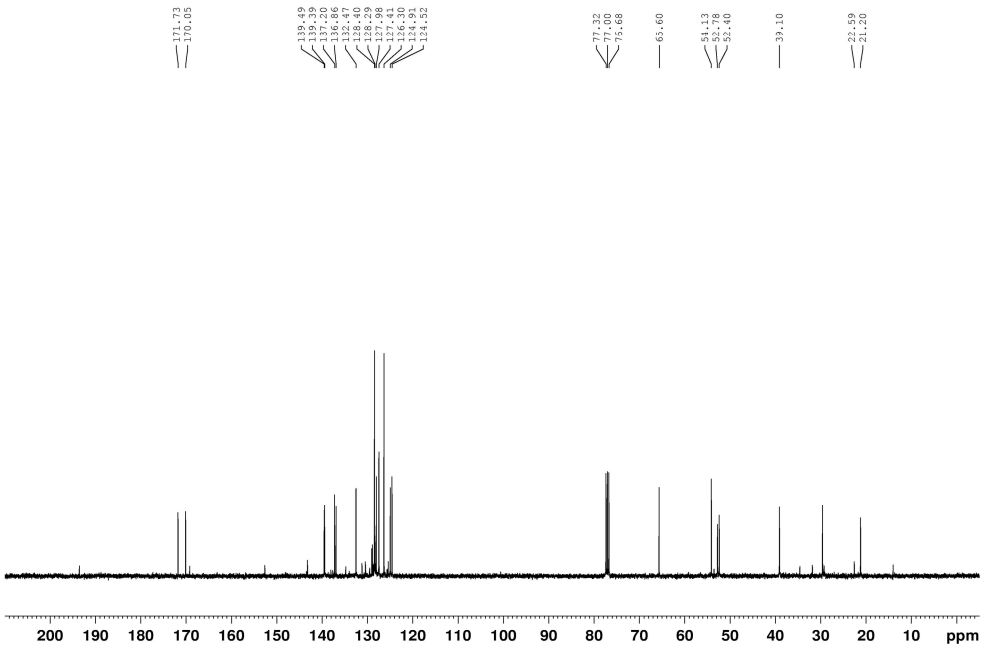

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

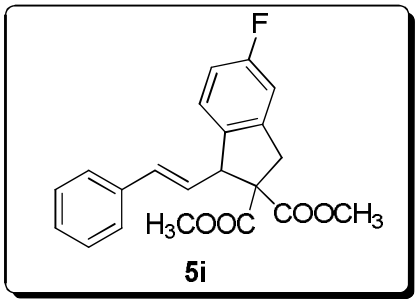

H3COOC
COOCH3

5h

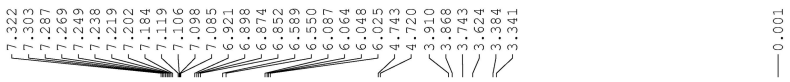

7.319
7.315
7.297
7.273
7.268
7.255
7.252
7.236
7.219
7.206
7.203
7.199
7.191
7.185
7.179
7.171
7.167
7.164
7.067
7.048
7.037
7.004
6.985
6.591
6.552
6.100
6.077
6.061
6.037
3.899
3.858
3.726
3.611
3.366
3.324
2.314
0.000

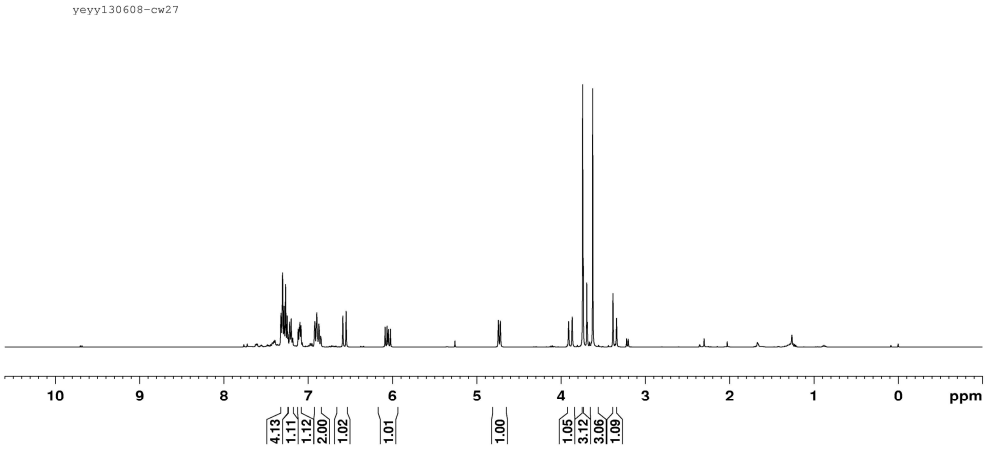

yeyy130610-cw26
10
9
8
7
6
5
4
3
2
1
0
ppm
2.15
2.12
1.08
2.08
1.09
1.01
1.01
1.00
1.05
3.00
3.00
1.07
3.06


171.73
170.05
139.49
139.39
137.20
136.86
132.47
128.60
128.29
127.98
127.41
126.30
124.31
124.52
77.32
77.00
75.68
63.60
54.13
52.78
52.40
39.10
22.59
21.20
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


F
H3COOC
COOCH3

5i


7.322
7.303
7.287
7.269
7.249
7.238
7.219
7.202
7.184
7.119
7.106
7.098
7.085
6.921
6.898
6.874
6.852
6.589
6.550
6.087
6.064
6.048
6.025
4.743
4.720
3.910
3.868
3.743
3.624
3.384
3.341
0.001


yeyy130608-cw27
10
9
8
7
6
5
4
3
2
1
0
ppm
4.13
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1.00
1.05
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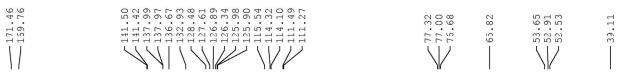
1.09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132.93
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125.90
115.54
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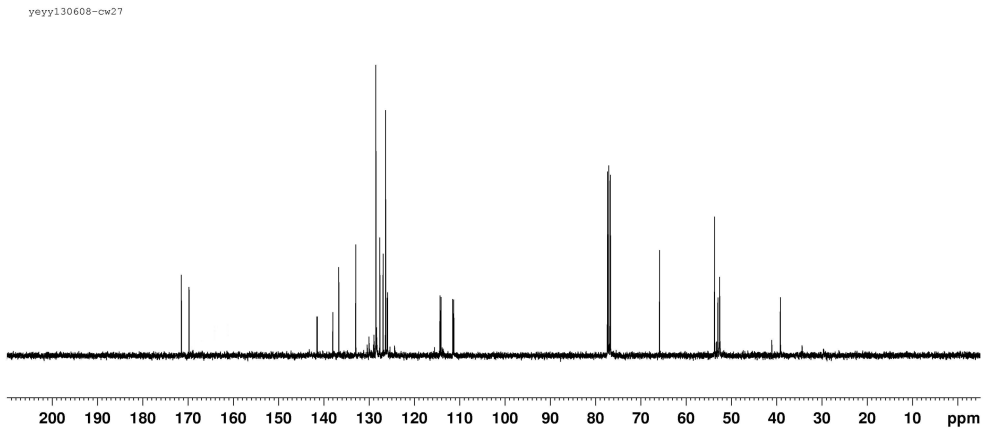
111.27
77.32
77.00
75.68
65.82
53.65
52.91
52.53
39.11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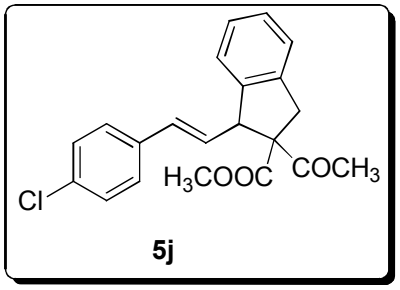
30
20
10
ppm


Cl
H3COOC
COCH3

5j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6.099
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6.060
6.037
5.978
5.954
5.939
5.915
4.799
4.769
4.745
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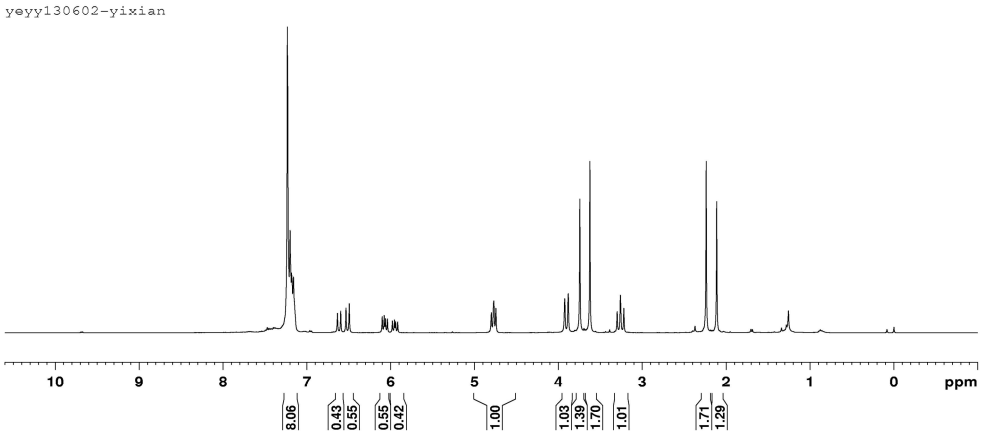
3.297
3.259
3.218
2.239
2.114
0.000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5
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0.55
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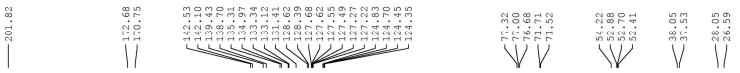
1.29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128.62
128.39
127.68
127.62
127.45
127.49
127.27
127.22
124.83
124.70
124.45
124.35
77.32
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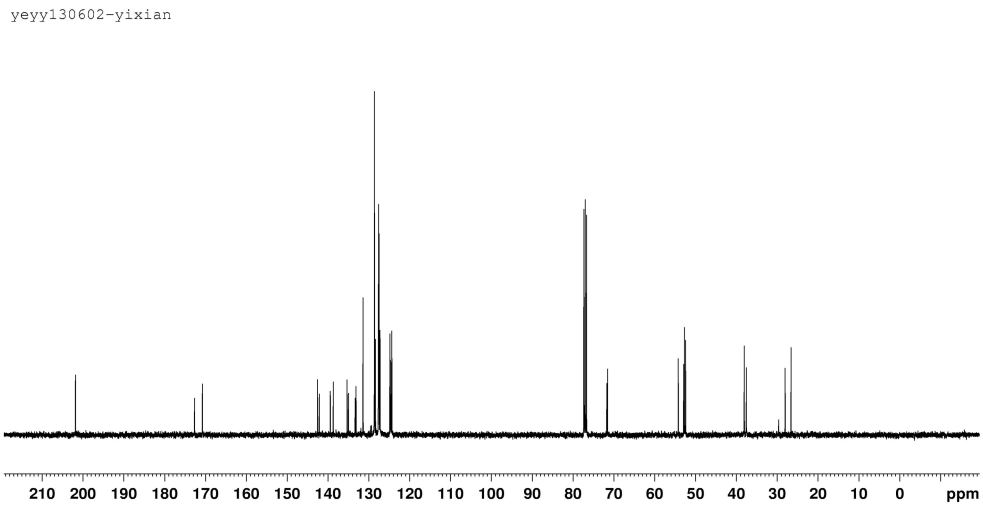
28.05
26.59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200
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130
120
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80
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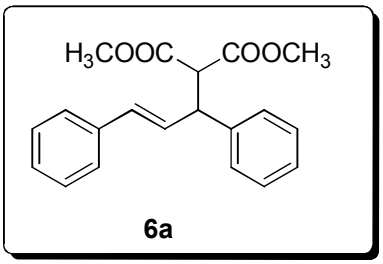
30
20
10
0
ppm



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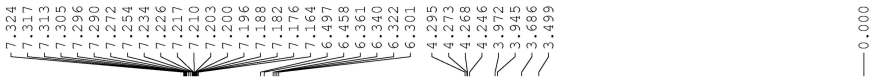
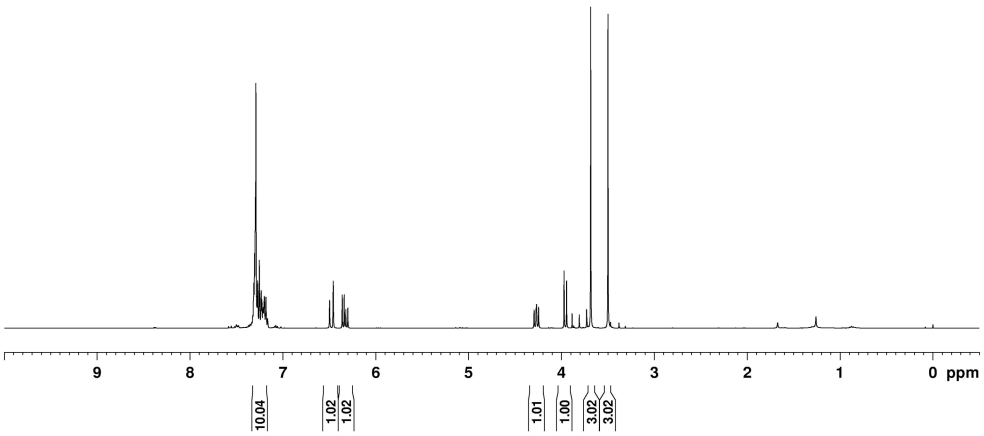


zpx20130508cw-1



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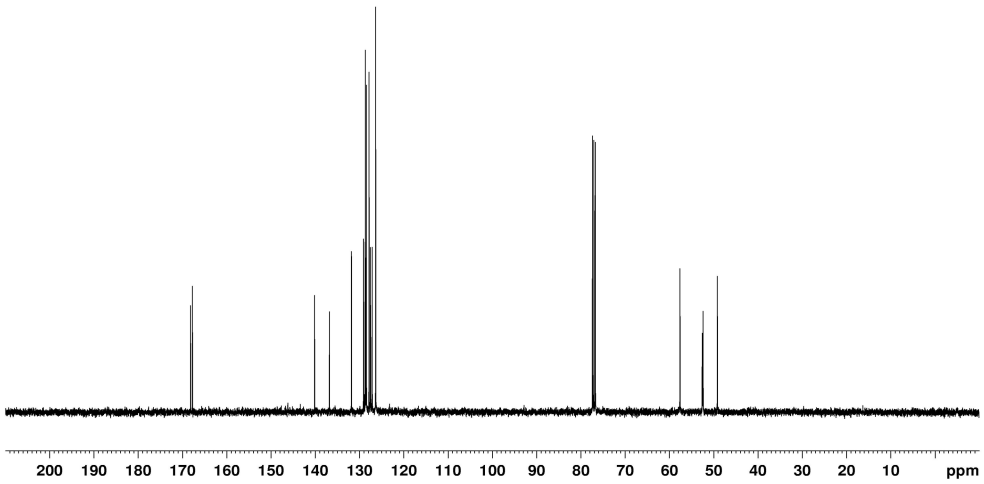
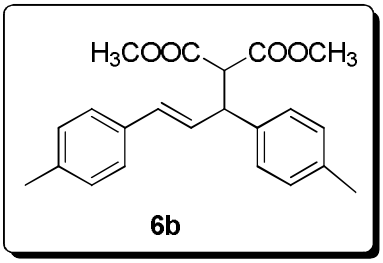
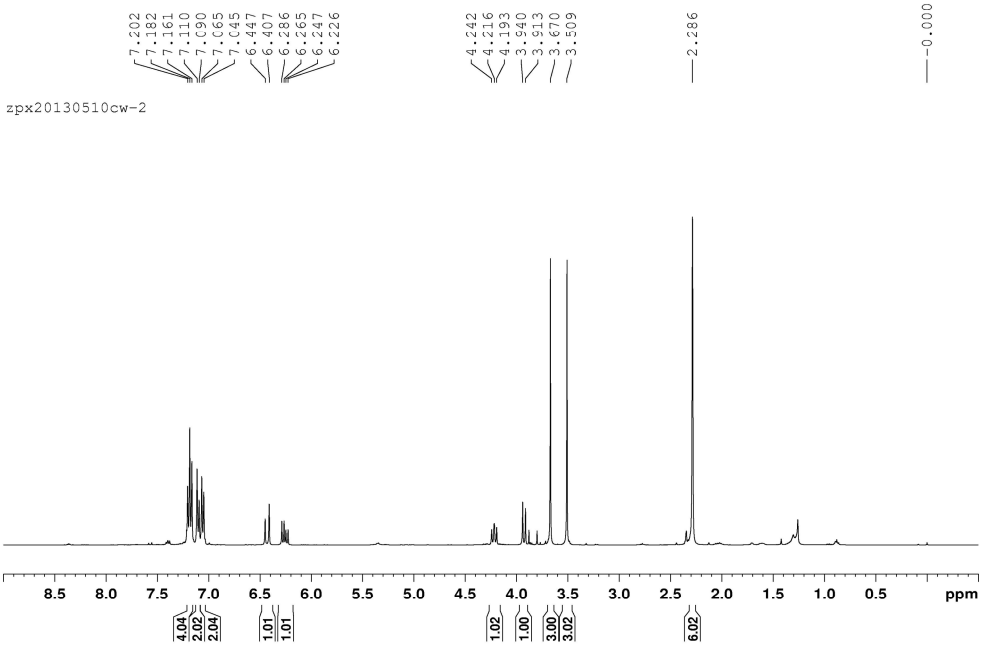



H3COOC
COOCH3

6b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7.161
7.110
7.090
7.065
7.045
6.447
6.407
6.286
6.265
6.247
6.226
4.242
4.216
4.193
3.540
3.513
3.670
3.509
2.286
0.000
zpx20130510cw-2
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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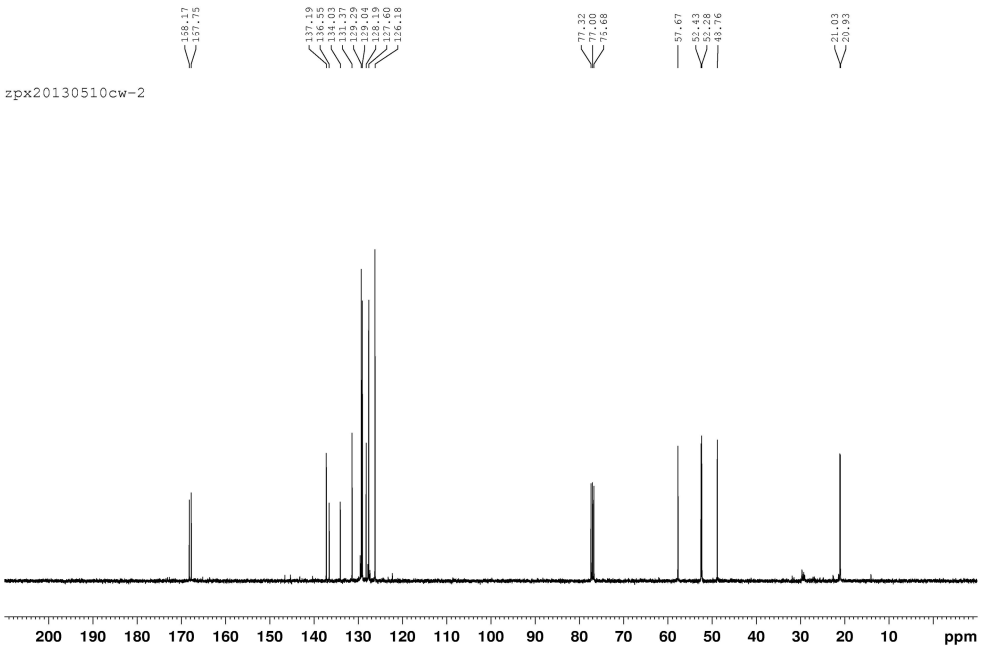
2.02
2.04
1.01
1.01
1.02
1.00
3.00
3.02
6.02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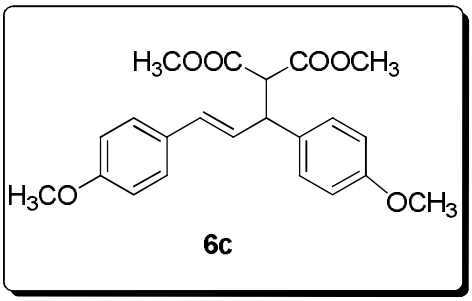
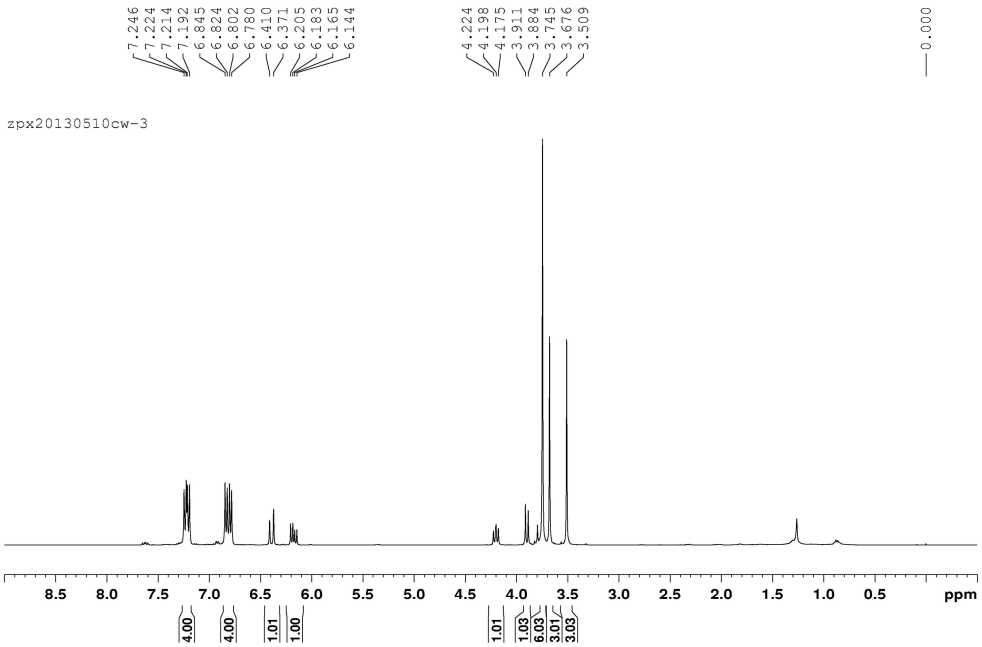
136.55
134.03
131.37
129.39
129.04
128.19
127.60
126.18
77.32
77.00
75.68
57.67
52.43
52.28
48.76
21.03
20.93
zpx20130510cw-2
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


H3COOC
COOCH3
H3CO
OCH3

6c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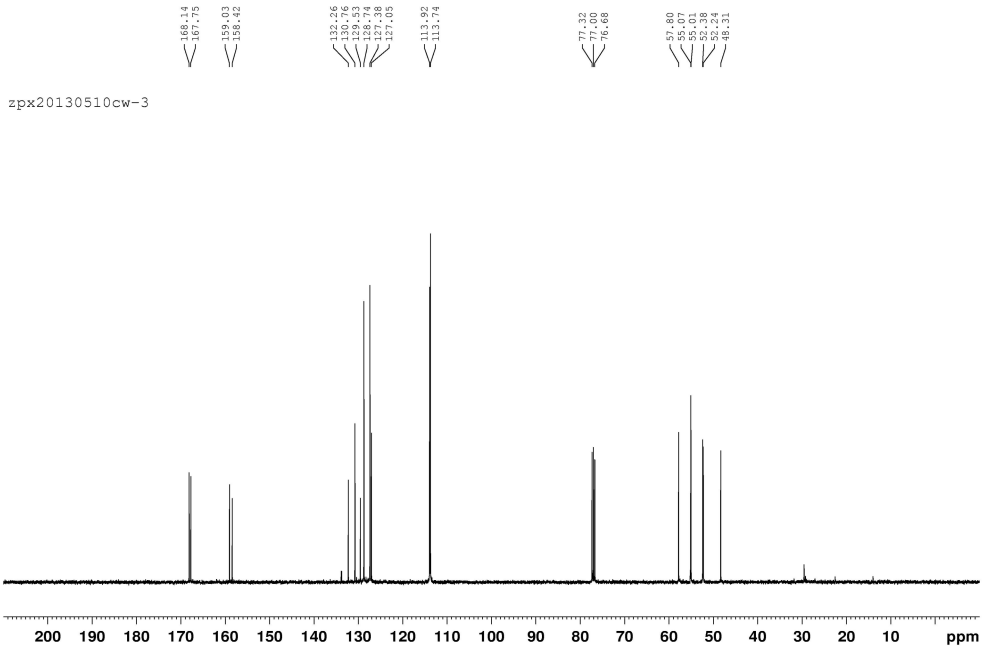
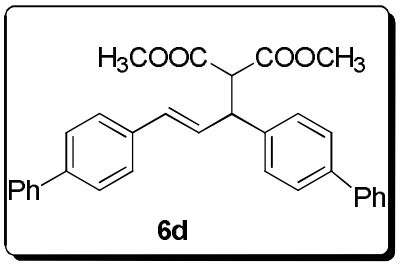
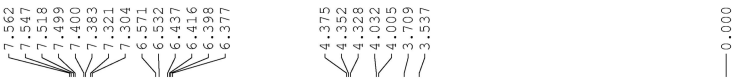
7.224
7.214
7.192
6.845
6.824
6.802
6.780
6.410
6.371
6.205
6.183
6.165
6.144
4.224
4.198
4.175
3.911
3.884
3.745
3.676
3.509
0.000
zpx20130510cw-3
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
4.00
4.00
1.01
1.00
1.01
1.03
6.03
3.01
3.03


168.14
167.75
159.03
158.42
132.26
130.76
129.53
128.74
127.38
127.05
113.92
113.74
77.32
77.00
76.68
57.80
55.07
55.01
53.38
52.24
48.31
zpx20130510cw-3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


H3COOC
COOCH3
Ph
Ph

6d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7.499
7.400
7.383
7.321
7.304
6.571
6.532
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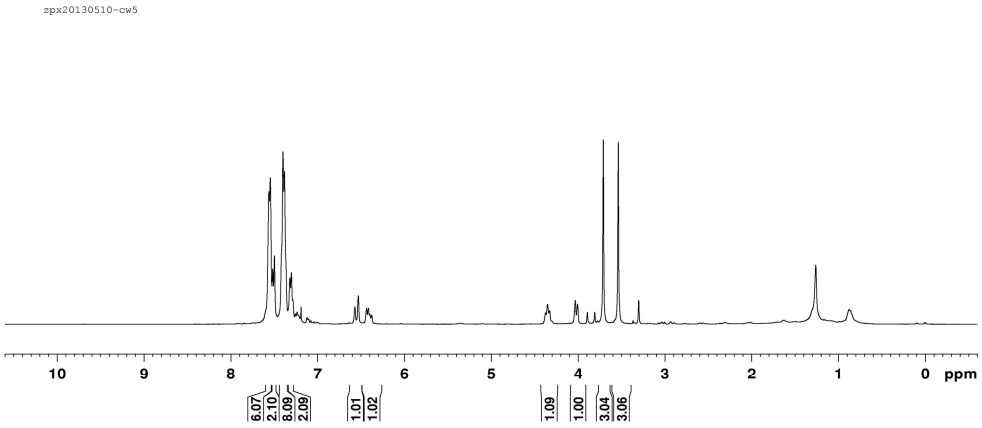
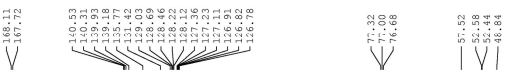
6.416
6.398
6.377
4.375
4.352
4.328
4.032
4.005
3.709
3.537
0.000


zpx20130510-cw5
10
9
8
7
6
5
4
3
2
1
0
ppm
6.07
2.10
8.09
2.09
1.01
1.02
1.09
1.00
3.04
3.06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139.18
135.77
131.42
131.10
128.69
128.46
128.22
128.12
127.36
127.23
127.11
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76.68
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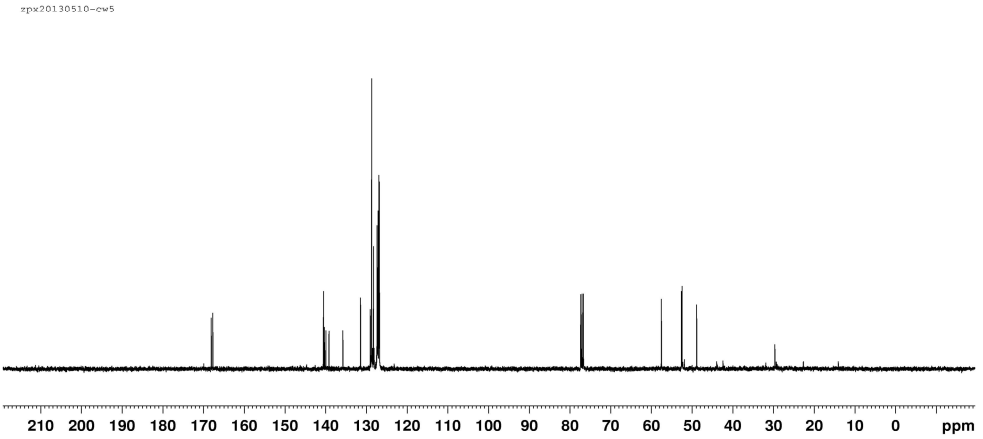
52.58
52.44
48.84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200
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180
170
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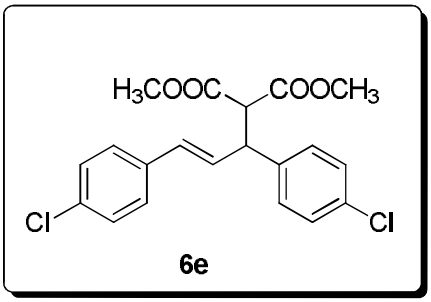
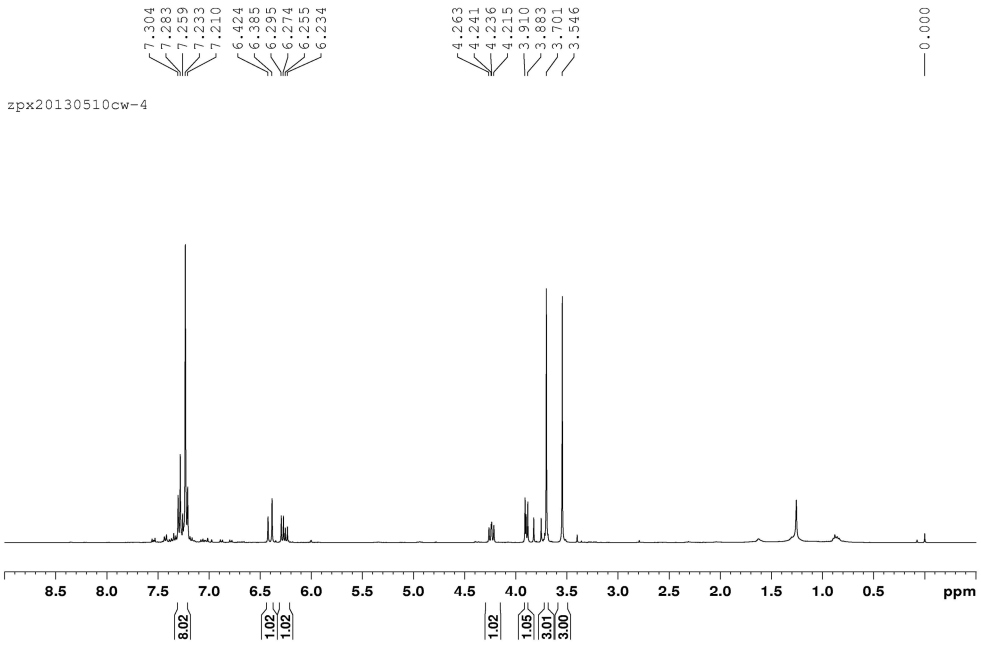
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


H3COOC
COOCH3
Cl
Cl

6e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6.295
6.274
6.255
6.234
4.263
4.241
4.236
4.215
3.910
3.883
3.701
3.546
0.000
zpx20130510cw-4
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
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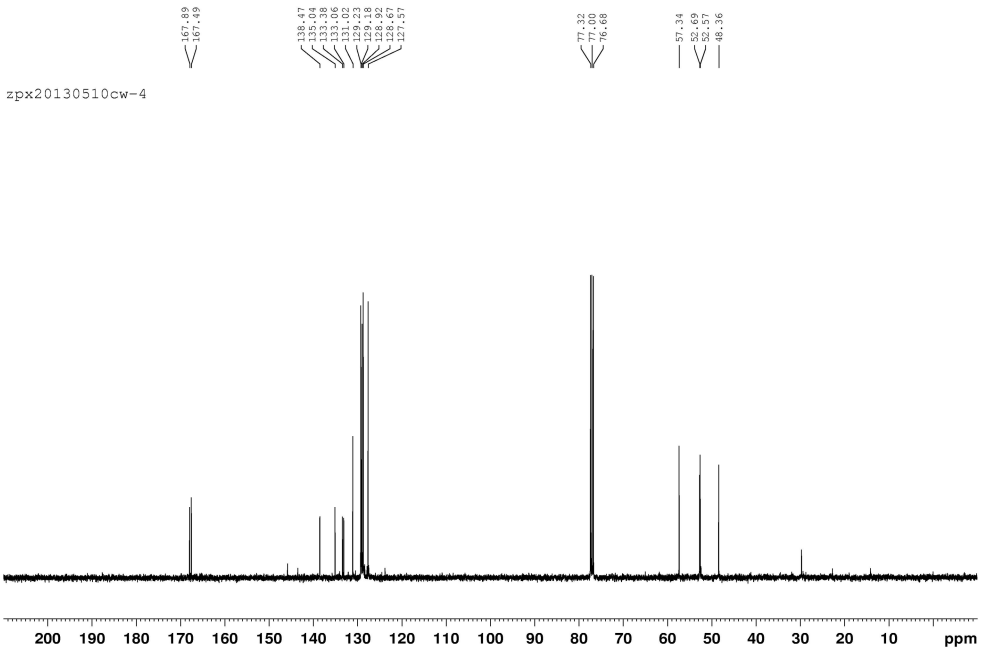
1.02
1.02
1.02
1.05
3.01
3.00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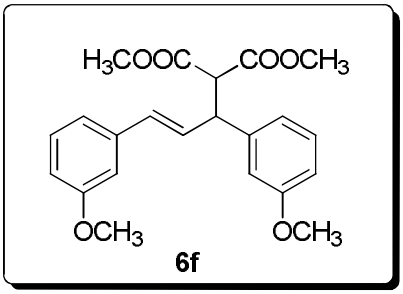
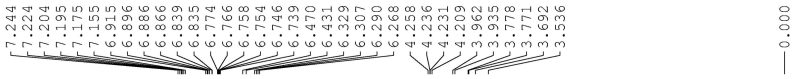
167.49
138.47
135.04
133.38
133.06
131.02
129.23
129.18
128.92
128.67
127.57
77.32
77.00
76.68
57.34
52.69
52.57
48.36
zpx20130510cw-4
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm


H3COOC
COOCH3
OCH3
OCH3

6f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6.835
6.774
6.766
6.758
6.754
6.746
6.739
6.470
6.431
6.329
6.307
6.290
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4.231
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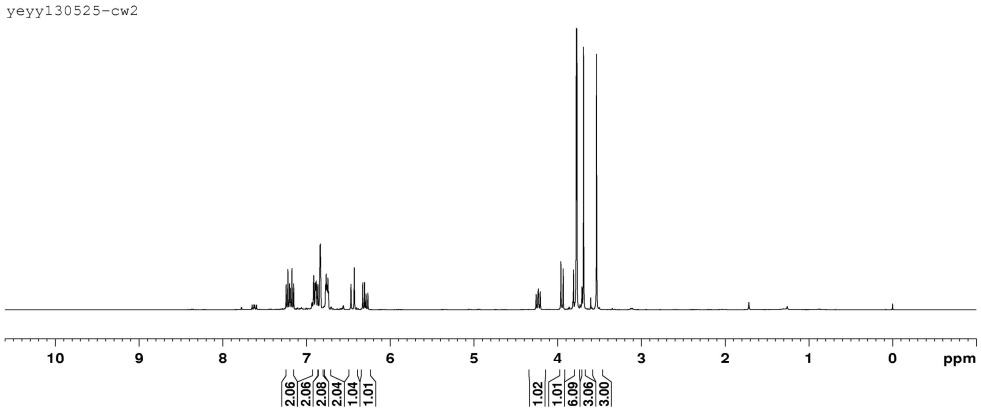
yeyy130525-cw2
10
9
8
7
6
5
4
3
2
1
0
ppm
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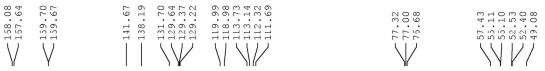
2.06
2.06
2.04
1.04
1.01
1.02
1.01
6.09
3.06
3.00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123.22
119.99
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113.73
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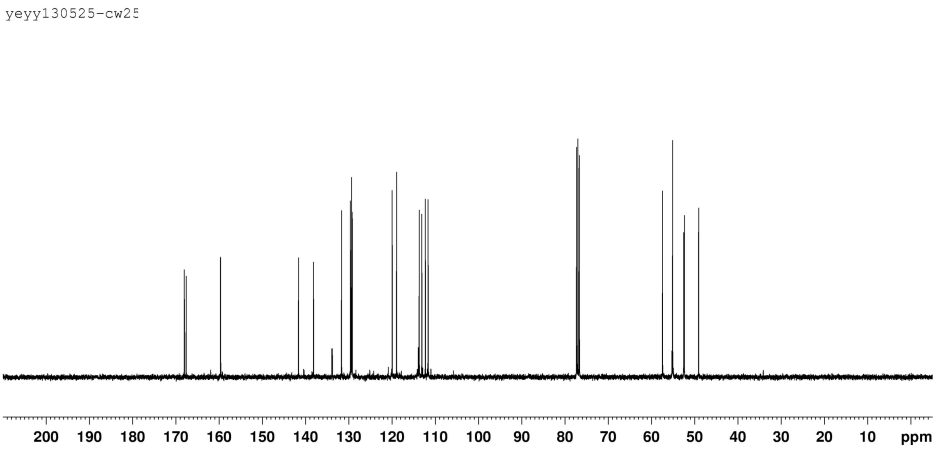
77.32
77.00
75.68
57.43
55.31
55.10
52.53
52.40
49.08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140
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90
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70
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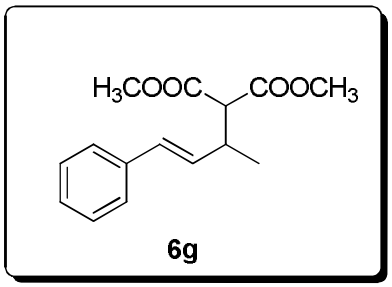
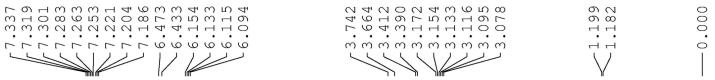
40
30
20
10
ppm


H3COOC
COOCH3

6g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7.263
7.253
7.221
7.204
7.186
6.473
6.433
6.154
6.133
6.115
6.094
3.742
3.664
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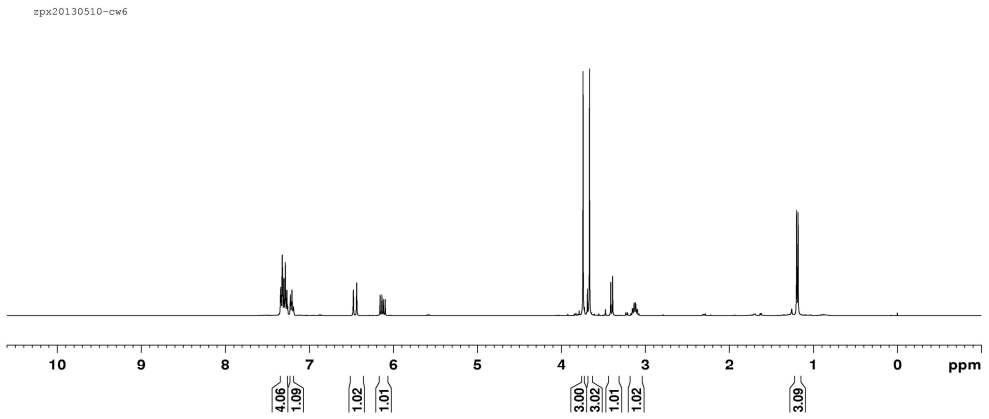
3.390
3.172
3.154
3.133
3.116
3.095
3.078
1.199
1.182
0.000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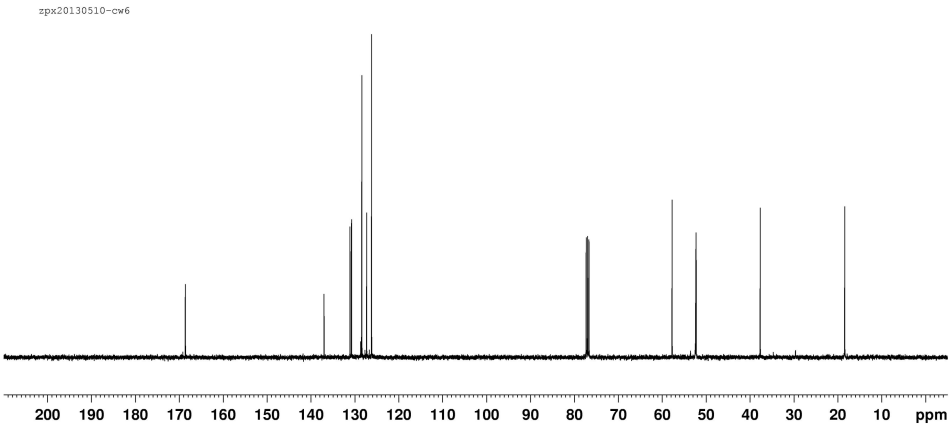
10
9
8
7
6
5
4
3
2
1
0
ppm
4.06
1.09
1.02
1.01
3.00
3.02
1.01
1.02
3.09


158.58
158.54
137.03
131.11
130.75
128.43
127.22
126.20
77.32
77.00
75.68
57.74
52.35
52.26
37.67
18.42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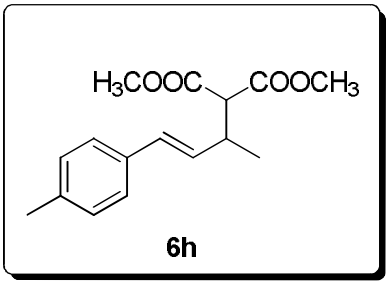
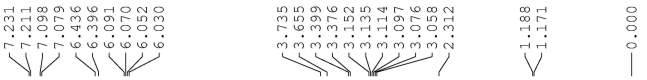
100
90
80
70
60
50
40
30
20
10
ppm


H3COOC
COOCH3

6h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7.079
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3.735
3.655
3.399
3.376
3.152
3.135
3.114
3.097
3.076
3.058
2.312
1.188
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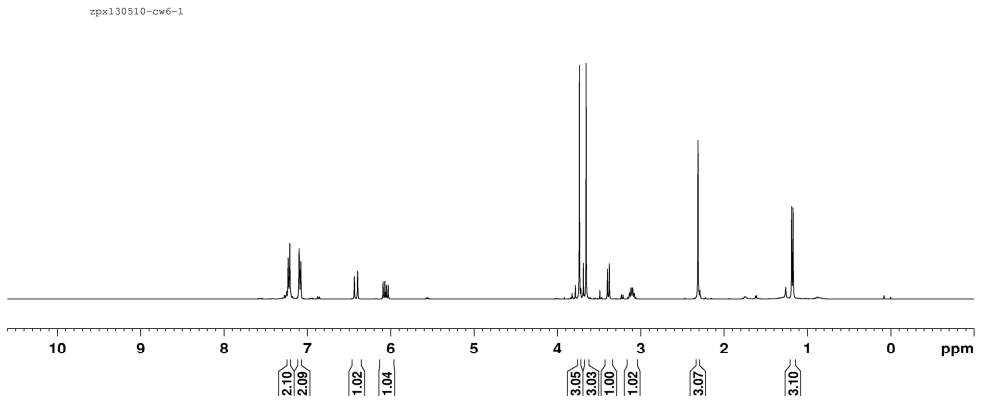
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7
6
5
4
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2
1
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2.10
2.09
1.02
1.04
3.05
3.03
1.00
1.02
3.07
3.10


168.60
168.56
137.07
134.25
130.88
130.55
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126.09
77.32
77.00
76.68
57.81
52.30
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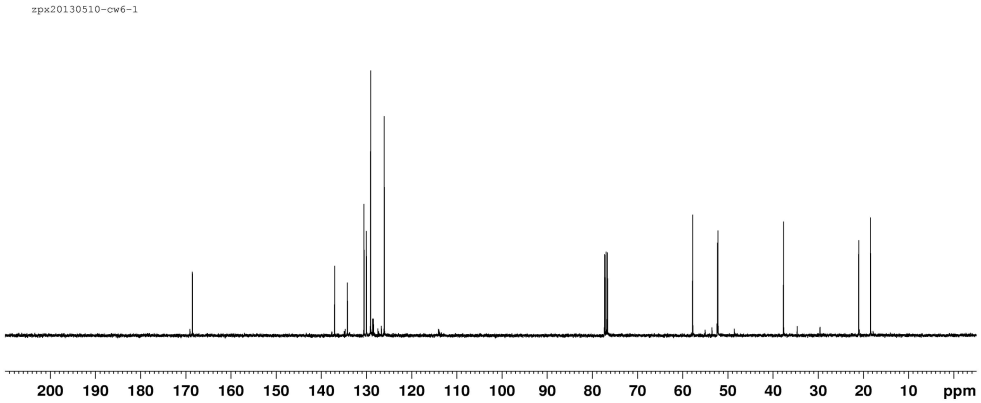
21.05
16.44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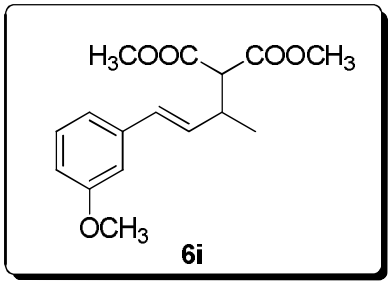
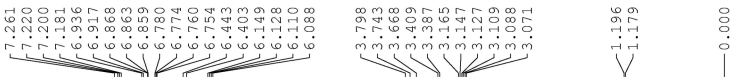

H3COOC
COOCH3
OCH3

6i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6.917
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6.760
6.754
6.443
6.403
6.149
6.128
6.110
6.088
3.798
3.743
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3.088
3.071
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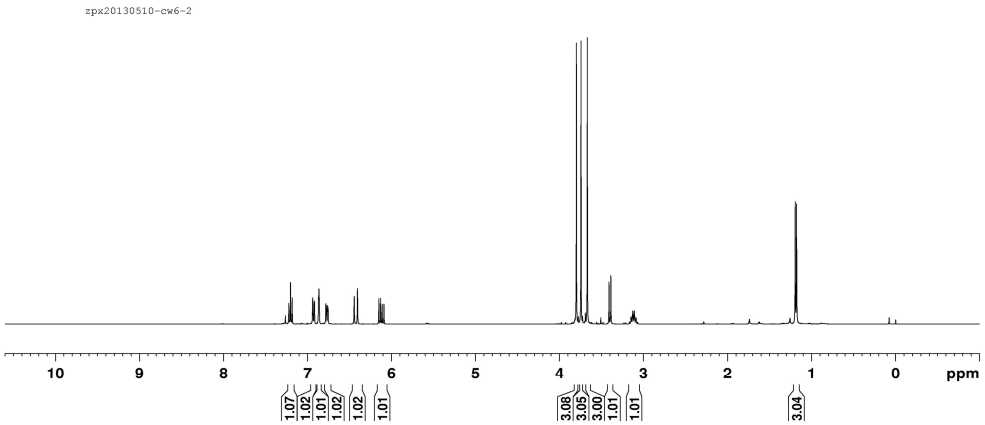
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1.01
1.02
1.02
1.01
3.08
3.05
3.00
1.01
1.01
3.04


168.54
168.51
159.70
138.49
131.43
130.65
129.39
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76.68
57.69
53.10
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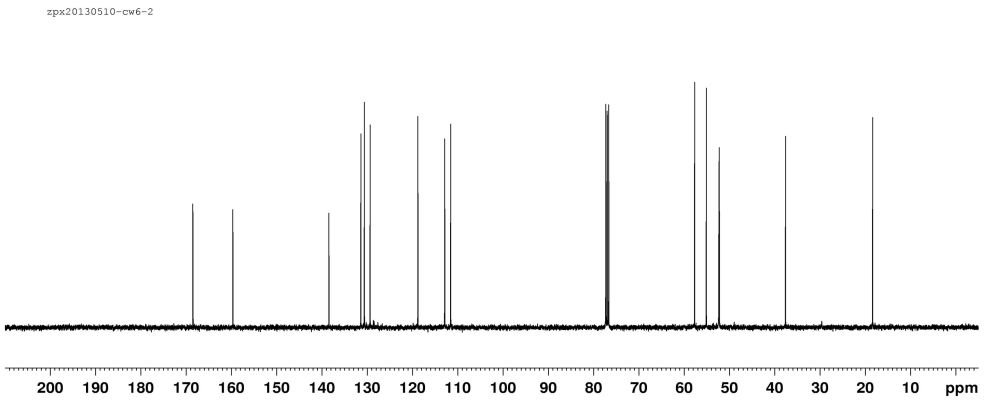
52.25
31.62
18.36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30
20
10
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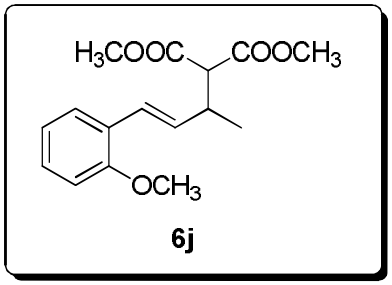

6j